A comprehensive review on the chemistry and pharmacology of Corchorus species—A source of cardiac glycosides, triterpenoids, ionones, flavonoids, coumarins, steroids and some other compounds

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An exhaustive literature survey on the secondary metabolites of Corchorus species has been carried out. Cardiac glycosides, triterpenoids, sterols, phenolics, ionones, carbohydrates and fatty acids have been reported from different species. Many of these compounds have been found to possess significant biological properties e.g. digitalis glycosides like action, anticonvulsive activity, antiesterogenic action, anticancer activity and antipyretic activity etc.

Keywords: Biological properties, Carbohydrates, Cardiac glycosides, Corchorus sp, Ionones, Phenolics, Sterols, Triterpenoids

Introduction

Corchorus (Family: Tiliaceae) is a genus of annual herbs. Nearly 40 species are known to occur in nature and distributed in the tropics of both the hemispheres. Seeds of C. acutangulus are used as a tonic, stomachic, purgative, in fever and in obstruction of the abdominal viscera. Leaves of C. capsularis, C. depressus and C. olitorius are demulcent, bitter, tonic, laxative, carminative, refrigerant, febrifuge, diuretic, useful in chronic cystitis, gonorrhoea and dysuria. C. depressus is given to increase the viscosity of the seminal fluid. Corchorus species have been reported to increase sexual ability in males. The evaluation is based on real experience and collective information from the local people who used them in their daily routine.

In view of the important medicinal properties attributed to this genus, this paper presents a comprehensive review giving chemical constituents (Table 1) and the biological activities of Corchorus, besides structures of the compounds, wherever known (Chart 1).

Cardiac Glycosides, their Aglycones and a few Uncharacterized Glycosides/Aglycones

Several glycosidic compounds, referred to as corchorin, were isolated from different Corchorus species but no definite conclusions could be drawn regarding the structures of these compounds. Similar was the fate of capsularin, chorchoritin and corchsularin. In the same manner, a number of aglycones namely corchsugenin, corchortoxin and corchorgenin were isolated. A significant advancement was made when these aglycones were chemically identified as strophanthidin, the familiar aglycone of the cardiac glycoside strophanthin. This was followed by identification of 2-deoxy riboside and 2-deoxy-3-O-methyl riboside of strophanthidin, though the position of the sugar residue was not defined.

Two digitalis glycosides, corchoroside A 2 (mp 188-90°, $[\alpha]_D^{20} = +11^\circ$ (MeOH)) and corchoroside B 15 (mp 222-24° $[\alpha]_D^{20} = +68^\circ$), were isolated respectively from C. capsularis and C. olitorius. Both showed similar colour reactions. A monoglucoside of corchoroside A from C. olitorius, a diglucoside and a triglucoside of corchoroside A were also identified in seeds of C. capsularis. Monoglucoside of corchoroside A was named as olitoriside.

Seeds of C. acutangulus yield helveticoside, corchoroside A 2 and an uncharacterized glycoside A (mp 155-60°), which on hydrolysis gave the sugar digitoxose while the aglycone part remained uncharacterized. An amorphous mixture of a glycoside, which on mild hydrolysis followed by chromatography gave strophanthidin and strophanthidol, was also obtained. The sugar part (paper and TLC examination)
Table 1—Chemistry of Corchorus Species

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<th>Sr No</th>
<th>Corchorus Species</th>
<th>Compounds isolated</th>
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<td>1</td>
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<td>Capsularol (leaves)</td>
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<td><em>C. trilocularis</em></td>
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<td>25, 26, Oxo-corocin (roots)</td>
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<td>Depressosides C &amp; D</td>
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<td>53, 54, 55 (leaves)</td>
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<td>62 (seeds)</td>
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(Contd)
was found to be a mixture of digitoxose 9 and boivinose 11 along with another uncharacterized fast moving sugar possibly 2,6-di-deoxy monomethoxy hexose. Loshkarev 27 reconfirmed the presence of corchoroside A in the seeds of C. olitorius. An extract of the seeds of C. olitorius and C. capsularis, after enzymic hydrolysis, gave a fair yield of corchoroside A, while this extract without enzymic treatment gave a lower yield of the expected product. Two other polar glycosides 30 isolated from seeds of C. acutangulus were identified as olitoriside (3, m p 205-08°) and erysimoside (5, m p 178-82°). The structures of these compounds were determined based on chemical and IR spectral data, the sugars were characterized by paper chromatography. Seeds of C. olitorius, besides erysimoside, gave a cardenolide glycoside, trisiose of strophanthinid, having a structure identical with the polar glycoside of C. capsularis 31a.

Seeds of C. capsularis gave a polar glycoside 31b, O-D- glucopyranosyl-β-(1→3)-O-D- glucopyranosyl β-(1→4)-D- bovinopyranosyl-β-(1→3)- strophanthinid. Energetic hydrolysis yielded glucose and no other hexose or pentose, whereas mild acid hydrolysis provided strophanthin as an aglycone. Controlled enzymic hydrolysis with β-glicosidase gave olitoribiose, glucose and boivinose, suggesting the sugar residue to be gluco-olitoribiose. Complete enzymic hydrolysis of the product gave corchoroside A suggesting that the glycoside is a higher homologue of corchoroside A. The periodate oxidation studies suggested that the nature of the linkage of glucose units is 1→3- β- linkage (laminaribiose residue). Laminaribiose residues were found for the first time as part of the cardiac glycosides 31b.

Seeds 32-35 of C. olitorius gave glycosides, corcoloside and deglycocoroloside, cardiac glucosides, cannarigenin 3-O-β-D-glucopyranosyl-(1→4)-O-β-D-allomethylpyranose/altromethylpyranose 13, canno- genol 3-O-β-D-glucopyranosyl-(1→4)-O-β-D-boivinopyranoside 6, permogenin 3-O-β-D-glucopyranosyl-(1→4)-O-β-D-digitoxopyranoside 7 and digitoxigenin 3-O-β-D-glucopyranosyl-(1→6)- O-β-D-glucopyranosyl-(1→4)- O-β-D-digitoxopyranoside 8 and some new cardiotonic oligoglycosides corchorosides A-E 16-20. C. olitorius seeds from Japan 36 contained cardiac glycosides (approx 1.0% level wet weight). The dark greyish green seeds contained more cardiac glycosides as compared to the dark greyish yellow or yellowish green seeds. The methanolic extract of seeds gave digitoxigenin glycosides, corcoloside and glucovatromonoside, as well as strophanthinid glycosides, erysimoside, olitoriside, corchoroside A and helveticoside, as the main cardiac glycosides.

Chloroform - butanol (1:3) fractions from the seeds of C. capsularis yielded polar glycosides A and B. Chloroform - alcohol (2:1) extracted residue gave glycoside B and a new polar glycoside C. Comparison with an authentic sample showed glycoside A to be erysimoside, which had not previously been reported from C. capsularis seeds. Glycoside C crystallized from isopropanol-methanol-ether, m p 200-10°/218-25° and was not identical with any compound isolated earlier from any Corchorus species.

Fermented seeds 38 of C. hirtus gave strophanthinid heterosides, glycosides a, b, c and d. Glycoside c was found to have boivinose 11 however a, b, and d were found to have boivinose and glucose as sugars. Petroleum ether extracted seeds 39 of C. capsularis and C. olitorius gave helveticoside (4, m p 168-71°, [α]D20 = +31.9 ± 2°). Its structure was confirmed by

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**Table 1—Chemistry of Corchorus Species—Contd**

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<tr>
<th>Sr No</th>
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<th>Compounds isolated</th>
<th>References</th>
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<tr>
<td>16</td>
<td>C. capsularis</td>
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<tr>
<td></td>
<td></td>
<td>64 (leaves)</td>
<td>44, 70</td>
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<tr>
<td>17</td>
<td>C. olitorius</td>
<td>63 (roots)</td>
<td>49a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64 (leaves)</td>
<td>51</td>
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<tr>
<td>18</td>
<td>C. depressus</td>
<td>64 (whole plant)</td>
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<td>19</td>
<td>C. fascicularis</td>
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<tr>
<td>20</td>
<td>C. olitorius</td>
<td>65, 66, 67, 68, 69, 70 (leaves)</td>
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<tr>
<td></td>
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<td>Glyceryl monopalmitate (leaves)</td>
<td>51</td>
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chemical and IR spectral data. Seeds\textsuperscript{40} of \textit{C. capsu-}

Chart 1

(1) Strophanthidin (R\textsubscript{1} = CHO, R\textsubscript{2} = OH, R\textsubscript{3} = H)
(2) Corchoroside A (R\textsubscript{1} = CHO, R\textsubscript{2} = OH, R\textsubscript{3} = \(\beta\)-D-boivinose)
(3) Olitoriside (R\textsubscript{1} = CHO, R\textsubscript{2} = OH, R\textsubscript{3} = \(\beta\)-D-boivinose-\(\beta\)-D-glucose)
(4) Helveticoside (R\textsubscript{1} = CHO, R\textsubscript{2} = OH, R\textsubscript{3} = \(\beta\)-D-digitoxose)
(5) Erysimoside (R\textsubscript{1} = CHO, R\textsubscript{2} = OH, R\textsubscript{3} = \(\beta\)-D-digitoxose-\(\beta\)-D-glucose)
(6) Cannogenol 3-O-\(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)4)-O-\(\beta\)-D-boivinopyranoside) (R\textsubscript{1} = CH\textsubscript{3}OH, R\textsubscript{2} = H, R\textsubscript{3} = \(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)4)-O-\(\beta\)-D-boivinopyranoside)
(7) Periplogenin 3-O-\(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)4)-O-\(\beta\)-D-digitoxopyranoside) (R\textsubscript{1} = CH\textsubscript{3}, R\textsubscript{2} = OH, R\textsubscript{3} = \(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)4)-O-\(\beta\)-D-digitoxopyranoside)
(8) Digitoxigenin -3-O-\(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)6)-O-\(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)4)-O-\(\beta\)-D-digitoxopyranoside (R\textsubscript{1} = CH\textsubscript{3}, R\textsubscript{2} = H, R\textsubscript{3} = \(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)6)-O-\(\beta\)-D-glucopyranosyl-(1\(\rightarrow\)4)-O-\(\beta\)-D-digitoxopyranoside

(9) D-Digitoxose (10) Strophanthidol (11) D-Boivinose
(12) 3,5- Dianhydroperiplogenin

(13) Canarigenin (R=O-β-D-glucopyranosyl-(1→4)-O-β-D-allomethylpyranose/allomethylpyranose
(14) Trilocularin (R=β-D-Boivinose)
(15) Corchoroside - B (R=α-L-Rhamnopyranose)

\[ Q_1 = \]

\[ Q_2 = \]

(16) Corchorusoside- A (R₁=R₂=OH, R₃=CH₃, R₄=Q₂)
(17) Corchorusoside- B (R₁=H, R₂=OH, R₃=CH₃, R₄=Q₁)
(18) Corchorusoside- C (R₁=OH, R₂=H, R₃=CH₃, R₄=Q₁)
(19) Corchorusoside- D (R₁=H, R₂=OH, R₃=CH₂OH, R₄=Q₁)
(20) Corchorusoside- E (R₁=OH, R₂=H, R₃=CH₂OH, R₄=Q₁)

(21) Corosin (R₁=OH, R₂=R₃=H)
(22) Cordepressic acid (R₁=R₂=H, R₃=OH)
(23) Cordepressin (R₁=H, R₂=OH, R₃=β-D-Galactose)

(24) Cordepressenic acid
(25) Ursolic acid \((R=H)\)
(26) Corosolic acid \((R=OH)\)
(25a) Oleanolic acid
(27) Corchorusin-A \((R=H)\)
(28) Corchorusin-C \((R=OH)\)
(29) Corchorusin-B \((R=\beta-D-Galactopyranose)\)
(30) Corchorusin-D \((R=Glucose-Galactose)\)
(31) Betulinic acid
(32) Depressoside-A \((R_1=Glucose, R_2=H)\)
(33) Depressoside-B \((R_1=Glucose, R_2=Ac)\)
(34) Depressoside E

(35) Capsin (R₁=Glucose, R₂=H)

(36) Capsugenin 30-O-Glucopyranose (R₁=H, R₂=Glucose)

(37) Trilocularol A (R=H)

(38) Trilocularol A-3 glucoside (R=β-D-Glucose)

(39) Trilocularoside A

(40) Corchoionoside – A

(41) Corchoionoside-B
(42) Corchoionoside C (R₁=CH₃, R₂=H)
(43) (6S, 9R)-Roseoside (R₁= H, R₂=CH₃)

(44) Betulabuseide A

(45) Cyanidin (R=H)
(46) Cyanidin glucoside (R= Glucose)

(47) Quercetin (R₁= R₂=OH)
(48) Kaempferol (R₁=OH, R₂=H)
(49) Apigenin (R₁= R₂=H)
(50) Luteolin (R₁= H, R₂=OH)
(51) Astragalin (R₁= O-Glc, R₂=H)
(52) Isoquercetin (R₁= O-Glc, R₂=OH)
(53) Quercetin-3- galactoside (R₁= O-Gal, R₂=OH)
(54) Quercetin-3- (6 malonyl glucoside) (R₁= O-6 malonyl glucose, R₂=OH)
(55) Quercetin-3- (6 malonyl galactoside) (R₁= O-6 malonyl galactose, R₂=OH)
(61) 3,5-Dicaffeoylquinic acid
(62) 4,7-dihydroxycoumarin

(56) Depressonol A
(57) Depressonol B

(58) Cichoriine (R=H)
(59) Scopolin (R=CH₃)
(60) Chlorogenic acid
laris on autofermentation followed by extraction with methanol gave monosides corchoroside A 2 and helveticoside 4, biosides, olitoriside 3 and erysimoside 5, and a trioside, a glycoside of strophanthidin having boivinose and two glucose units as sugars. Seeds of C. trilocularis, on autofermentation, yielded two crystalline glycosides and two genins. Genins were identified as 3,5-dianhydroperiplogenin 12 and canarigenin 13, which might be artifacts. The major glycoside, trilocularin 14, was identified as 3-O-β-D-boivinose of canarigenin. The minor glycoside was identical with corchoroside B 15, which is α-L-rhamnopyranoside of canarigenin. Strophanthidin, strophanthidol, corchoroside A, helveticoside and olitorin were isolated from seeds of C. olitorius 43.
Leaves of *C. capsularis* yielded glycosides, capsulasone (mp 258-60°, [α]D 26 = +42.8° (EtOH)), corchorol \( \{C_{22}H_{28}O_{9}\}, \text{mp} 184°, [\alpha]_D^{20} = -22.6° (\text{EtOH}) \) and capsularol \( \{C_{41}H_{30}O_{11}\}, \text{mp} 204-05°, [\alpha]_D^{20} = -20.7° (\text{EtOH}) \) besides KCl (4%) and small quantities of glucose, galactose and arabinose as free sugars. Capsularol, on acid hydrolysis, yielded glucose and an aglycone, capsularogenin \( \{C_{35}H_{60}O_{6}\}, \text{mp} 217°, [\alpha]_D^{20} = +2.97° (\text{EtOH}) \).  

**Polysaccharides and Some Other Sugars**

An acidic polysaccharide, isolated from water-soluble mucilage extracted from dried leaves of *Corchorus olitorius*, was rich in uronic acid (65%), and consisted of rhamnose, glucose, galacturonic acid and glucuronic acid in a molar ratio of 1.0: 0.2: 0.2: 0.9:1.7 in addition to the acetyl group (3.7%). A methylation analysis, Smith degradation study and fragmentation analysis suggested that this polysaccharide mainly consisted of O-4 substituted galacturonic acid and glucuronic acid and O-2 substituted rhamnose residues and that most of the (1→4)- linked uronic acid residues were substituted at the O-3 position with glucuronic acid residues. Free sugars, raffinose, sucrose, arabinose, fructose, glucose and galactose have been reported in the extracts of seeds of *C. capsularis* and *C. olitorius*, while raffinose, arabinose, fructose and glucose are reported in the root extracts. Oligosaccharide components of the seeds of *C. capsularis* and *C. acutangulus* were isolated and identified as sucrose, raffinose, stachyose and verbascose. Fructose and galactose were identified in the bark of *C. capsularis*.

**Triterpenoids**

A triterpenoid corosin, isolated from roots of *C. capsularis* and *C. olitorius*, on refluxing with HCl, gave corosic acid \( \{C_{39}H_{40}O_{6}\}, \text{mp} 247-49°, [\alpha]_D^{26} = +127 (0.9\% \text{ in MeOH}) \), however, structures of both these compounds were not established. Further extension of the work established structure of corosin \( \text{21} \), which on treatment with sulphuric acid and acetic acid gave the anhydrolactone by dehydration of one molecule of water involving OH group at C-19 and carboxylic acid group at C-17 position. Ursolic acid \( \text{25} \), corosolic acid \( \text{26} \) and o xo-corosin were isolated from fresh, undried roots of *C. capsularis* and *C. olitorius*. Isolation of oleanolic acid \( \text{25a} \) also has been reported from the leaves of *C. olitorius* of Egyptian origin. Four triterpenoid glycosides (chorchorusins rusins A, B, C and D), isolated from aerial parts of *C. acutangulus*, were respectively defined as longispino-genin-3-O-β-D-galactopyranoside \( \text{27} \), saikogenin-3-O-β-D-galactopyranoside \( \text{29} \), hydroxylisoptigenin-3-O-β-D-galactopyranoside \( \text{28} \) and saikogenin-3-O-β-D-gluco-pyranosyl-(1→2)-β-D-galactopyranoside \( \text{30}^{52,53} \).

A pentacyclic triterpene betulinic acid \( \text{31} \) was isolated from *C. fascicularis*. Whole plant \( \text{54}^{55,56} \) of *C. depressus* gave α- amyrin derivatives, cordepressic acid (2α, 3β, 20β-trihydroxy-urs-12-ene-24, 28-dioic acid) \( \text{22} \), cordepressin (2α, 3β, 20β-trihydroxy-urs-12-ene-24, 28-dioic acid 24β-D-galactoside) \( \text{23} \) and cordepressenic acid (2α, 3β-dihydroxy-urs-12-20-diene-24-28-dioic acid) \( \text{24} \), and cycloartane glycosides, depressoside A \( \text{32} \) and depressoside B \( \text{33} \) characterized as 9, 19-cyclolanostan-22 (R), 25-epoxy-3β, 16β, 24 (S)-triol-3-O-β-D-glucopyranoside and 9,19-cyclolanostan-22 (R), 25-epoxy-24 (S) acetoxyl-3β, 16β-diol-3-O-β-D-glucopyranoside respectively. Two novel bidesmisidic cycloartane type glycosides, depressosides C and D were also isolated from whole plant of *C. depressus* and their structures were established as (22 R) 16β, 22-epoxy-3β, 26-dihydroxy-9, 19-cyclolanostan-24 E ene 3, 26-di-O-β-D-glucopyranoside and (22 R, 24S)-22, 25-epoxy-3β, 16β, 24-trihydroxy-9, 19-cyclolanostane 3, 24-di-O-β-glucopyranoside respectively.

The butanol soluble part of the ethyl alcohol extract of *C. depressus* gave depressosides E \( \text{34} \), (22R,24S)-22, 25-epoxy-cyclolanostane-3β, 16β, 24-triol-3(αL-rhamnopyranosyl-(1→4))β-D-(22R,24S)-22, 25-epoxy-9, 19-cyclolanostan-3β,16β,24-triol-3(α-D-glucopyranosyl-β-D-glycopyranoside) \( \text{58} \) and depressoside F, of which structure was not given.

The leaves of *C. capsularis* gave a new dammarane triterpene glycoside, capsin \( \text{35} \), 3-glucoside of 20, 24-epoxy-3β, 12β, 25, 30- tetrahydroxydammarane (capsugenin) \( \text{59,60} \). Later on, one more new triterpenic glucoside capsugenin 30-O-glucopyranoside \( \text{36} \) was isolated from the mature leaves of *C. capsularis* \( \text{61} \). Whole plant of *C. trilocularis* \( \text{62} \) yielded two tetra-cyclic triterpenoids, trilocarol A \( \{3β, 6α, 16α, 20 (S), 27- pentahydroxy- dammar-24 (Z)-ene, \text{37} \} \) and its 3-glucoside \( \text{38} \), besides one pentacyclic triterpenoid trilocaroloside \( \{2α, 3β, 19α, 30-tetrahydroxy-urs-12- en-24, 28-dioic acid-28-O-β-D-glucopyranosyl ester, \text{39} \} \).
Ionones

Leaves of C. olitorius contain ionone glucosides, corchoinosides A 40, B 41 and C 42, an ionone glucoside (6S, 9R) rosegoside 43 and a monoterpene glucoside betulabuse A 44.

Phenolics

Isolation and characterisation of cyanidin 45 and cyanidin glucoside 46 from C. capsularis bark 54; cyanindin glucoside from C. capsularis leaves 46; quercetin 47 from C. acutangulus whole plant 65; quercetin, kaempferol 48 from C. depressus leaves & flowers 66; apigenin 49 and luteolin 50 from C. depressus whole plant 58 and astragalin 51 and isoquercitrin 52 from C. olitorius leaves 63 have been reported. Leaves 51, 67 of C. olitorius (Egyptian origin) also contain four flavonoidal glycosides, astragalin (kaempferol-3-O-β-D-glucopyranoside), tolifolin (kaempferol-3-O-β-D-galactopyranoside), isoquercitrin (quercetin-3-O-β-D-glucopyranoside) and jugulanin (kaempferol-3-O-β-L-arabinopyranoside), besides quercetin-3-α-L-arabinopyranoside 53, quercetin-3-(6 malonyl glucoside) 54 and quercetin-3-β-D-galactoside 55 (tentative). The butanol soluble part of the ethyl alcohol extract of C. depressus 58 gave flavonol glycosides, depressonol A 56 [kaempferol-3-β-D-glucopyranosyl-(1→4)-β-D-galactopyranoside] 7-[α-L-arabinofuranoside] and depressonol B 57 [kaempferol-3-[β-D-glucopyranosyl- (1→6)-β-D-galactopyranoside] 7-[α-L-arabinofuranoside].

Two coumarin glucosides, cichorine 58 and scopolin 59 were isolated from the leaves of C. olitorius 63, the first report of the isolation of coumarins from this genus. Isolation of 5-caffeoylquinic acid (chlorogenic acid) 63, 67 60 and 3, 5-dicaffeoylquinic acid 67, 61 from the leaves of C. olitorius have also been reported. From chloroform extract of defatted seeds of C. olitorius, a new coumarin was isolated as 4, 7-dihydroxycoumarin 62, 68.

Fatty Acids

Fatty acid composition of seed oil of C. olitorius was reported earlier 74. Leaves 72 of C. olitorius gave four higher fatty acids with a triene system, corchorifatty acids A 65, B 66, C 67, D 68, an undecanoic acid, corchorifatty acid E 69 and a trihydroxy fatty acid, corchorifatty acid F 70. Presence of glyceryl monopalmitate has been reported in leaves of Egyptian origin 51.

Sterols

Isolation of β-sitosterol 63 from C. capsularis seeds 69, roots 46, 49a, and leaves C. olitorius roots 49a and C. fascicularis 54, β-sitosterol-D-glucoside 64 from C. capsularis leaves 64, 70 and C. depressus whole plant 55 and β-sitosterol and β-sitosterol 3-O-β-D-glucopyranoside from the leaves of C. olitorius of Egyptian origin have been reported 51.
creased sharply and terminated with ventricular fibrillation. Results suggested the presence of active ingredients in the seed extract associated with direct effects on the myocardium.

A new glycoside from *C. fascicularis* showed spasmylocytic action on guinea pig ileal smooth muscle against acetylcholine-, bradykinin-, and histamine-induced contractions. This glycoside showed positive colour reactions for flavonoids and gave glucose on hydrolysis. It showed little cardiodepressant activity in amphibian heart perfusion.

**Antihistaminic Activity**

Corchoionoside A 40, B 41 and (6S, 9R)- roseoside 43 from *C. olitorius* inhibit the histamine release from rat peritoneal exudate cell induced by antigen- anti-body reaction.

**Hepatobiliary, Renal and Haematological Changes**

An increase in body weight (including weight of liver) was noticed in test animals after feeding with a protein-enriched diet from *C. olitorius* seeds. AST, ALT and total lipid of liver increased significantly whereas AST and ALT of serum decreased. A cholesterol free diet containing dried green leaves powder of *C. olitorius* lowered hepatic cholesterol concentration and increased neutral fecal bile acid and neutral sterols excretion in rats.

Effects of multiple weekly dose of methanolic extract of *C. olitorius* (15, 20, 25 mg/kg.i.p.) on liver and kidney functions and haematological parameters in mice were studied. No significant alteration of RBC count and haemoglobin content was observed in all dose levels of the treatment whereas significant increase in clotting time was seen in moderate and high doses. The extract caused significant increase in WBC count only at a high dose level of treatment. SGOT, SGPT, NPN and plasma cholesterol levels increased significantly at medium and high dose levels. Serum alkaline phosphatase and total bilirubin levels were also increased by both moderate and high dose levels of treatment. Low doses of the extract did not exhibit any significant change of creatinine and serum protein levels, but the high dose level significantly increased creatinine level.

**Antimalarial Activity**

Aqueous extract of *C. olitorius* showed a strong growth inhibition (>96%) of the malaria parasite *Plasmodium falciparum*. Methanolic extract of *C. olitorius* showed a significant anticonvulsive activity by altering the levels of catecholamines and brain amino acids in mice.

**Anticonvulsant Activity**

Methanolic extract of *C. olitorius* showed a remarkable delay in sexual maturation in mice as evidenced by the age at vaginal opening and appearance of first esterus (cornified smear). It also resulted in a significant diminution of Δ5-3β-hydroxysteroid dehydrogenase (HSD) and glucose-6- phosphate dehydrogenase (G-6-PD) activity along with a reduction in the weight of ovary, uterus and pituitary. The probable cause of delayed maturation may be due to the suppressed ovarian steroidogenesis.

**Antioestrogenic Activity**

Methanolic extract of *C. olitorius* seeds arrested normal oestrous cycle of adult female mice and significantly decreased weight of ovaries and uterus. Cholesterol and ascorbic acid contents in ovaries were significantly increased in treated mice. After 17 days of treatment, two key enzymes, Δ5-3-β-hydroxysteroid dehydrogenase and glucose-6-phosphate dehydrogenase, were decreased significantly. High level of substrates and low level of enzymes indicated inhibition of steroidogenesis in treated mice, which may be due to the presence of flavonoids.

**Anticancerous Activity**

Alcoholic extract of entire plant *C. aestuans* showed anti-cancer activity against human epidermal carcinoma of the nasopharynx in tissue culture.

**Analgesic and Antipyretic Activity**

Cordepressic acid possesses antipyretic activity on yeast-induced pyrexia at a dose of 100 mg/kg body weight in albino rats. The effect was particularly marked when it was administered intraperitoneally. It also exhibited a significant analgesic activity on acetic acid induced writhing in mice at a dose of 100 mg/kg orally and on response to electrical stimulus of mice in pododolorimeter at a dose of 500 mg/kg orally. However, it was devoid of analgesic activity against thermal/ mechanical stimuli. Toxicity studies showed it tolerant up to 500 mg/kg, i.p. in mice. *C. depressus* whole plant extract (hexane & chloroform soluble) exhibited prominent antipyretic activity in rabbits receiving subcutaneous yeast injections and it did not show any toxic or adverse effect up to an oral dose of 1.6 g/kg.
Inhibitory Effect on Nitric Oxide Production

Corchorifatty acids A 65, B 66 and C 67 showed an inhibitory effect on lipopolysaccharide-induced NO production in cultured mouse peritoneal macrophages.72

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References


