Review Article: Bioactive Compounds and Antischistosomal Activity of Dolichos Species: A Review

Nasiru Malan Musa[1,*], Muhammad Sani Sallau[2], Adebayo Ojo Oyewale[2], Tijjani Ali[3]

[1]Department of Chemistry, College of Natural and Applied Sciences, Al-Qalam University Katsina, Katsina State, Nigeria
[2]Department of Chemistry, Faculty of Physical Sciences, Ahmadu Bello University Zaria, Kaduna State, Nigeria
[3]Department of Chemistry, Faculty of Physical Sciences, Federal University Dutsin-Ma, Katsina State, Nigeria

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ABSTRACT

This review focuses on the isolated bioactive compounds and antischistosomal activity of Dolichos species, particularly Dolichos biflorus and Dolichos lablab. Medicinal plants have been used since ancient times and continue to play a significant role in traditional medicine and drug discovery. Dolichos species are known for their therapeutic potential and have been traditionally used in Nigeria. The review presented the chemical compounds isolated from Dolichos species, including triterpene bisdesmosides and lectins. Compounds with antischistosomal activity were also explored. The findings highlight the importance of Dolichos species as potential sources of bioactive compounds for the development of novel therapeutic agents.

Nasiru Malan Musa: He is a Ph.D. student in Organic Chemistry Ahmadu Bello University Zaria, Kaduna State and a lecturer in the Department of Chemistry, College of Natural and Applied Sciences, Al-Qalam University Katsina, Katsina State, Nigeria.

***Corresponding Author: Nasiru Malan Musa** (nmmusabt@gmail.com)*

Muhammad Sani Sallau: He is a co-author and professor in the Department of Chemistry, Faculty of Physical Sciences, Ahmadu Bello University, Zaria Kaduna State, Nigeria. He is skilled in Curriculum Design, Matlab, Simulation.

Adebayo Ojo Oyewale: He is a co-author and professor in the Department of Chemistry, Faculty of Physical Sciences, Ahmadu Bello University Zaria, Kaduna State Nigeria. He specialized in synthesis, isolation, and characterization of organic molecules using 1D and 2D NMR spectroscopy.

Tijjani Ali: He is a co-author and associate professor in the Department of Chemistry, Federal University Dutsin-Ma, Katsina State, Nigeria. His research interest mainly focuses on plant-derived antimicrobial naturally occurring molecules. He specialized on isolation, characterization, and pharmacological studies of phytocompounds.

Content

1. Introduction

Since the origin of medicine, natural products, particularly those produced from plants, have been used to help mankind maintain human health [1]. Traditional medicine has existed since the beginning of time and it has been widely acknowledged and used by people throughout history [2]. Plants have been utilized as a source of medicine since the dawn of humanity [3, 4]. For many years, plant-derived therapeutic medicines have piqued the interest of experts all over the world due to their low side effects and good impacts on human health [5]. Plant's use in medicine dates back to the Greek physician Dioscorides, who published De Materia Medica in 28 A.D., which comprised 600 medicinal plants and was the main work on pharmacology until the Renaissance [6, 7]. Willow tree leaves of the plant may have been prescribed by Hippocrates to treat fever [8, 9]. Salicin, an anti-inflammatory and pain-relieving compound, was initially isolated from the white willow tree, and then synthesized to become a popular over-the-counter medication [10, 11]. Plants having a long history of ethnomedicinal uses can be a valuable source of substances for the treatment of various ailments and infectious diseases in the pharmaceutical field [12].

Medicinal plants are thought to be a reservoir of various bioactive chemicals with various medicinal qualities [13]. Anti-inflammatory, antiviral, anticancer, antimalarial, and analgesic activities are among the many therapeutic benefits linked with medicinal plants [14, 15]. According to the World Health Organization (WHO), diverse medicinal plants can be used to make a range of pharmaceuticals [16] and around 80 % of the world's developing population relies on traditional medicines for their primary health care [1, 17].
Plants have a natural advantage of producing pharmaceutical chemicals [18], and their characterization has led to the identification of new, low-cost medications with excellent therapeutic potential [19, 20]. Medicinal plants play an important role in rural livelihoods [21]. Many people are active in collecting and trading medicinal plants [22], in addition to traditional healers who practice herbal medicine [23]. The result is an increased demand in both local and international markets as well as bio-prospecting activities searching for sources of new drugs [24, 25].

According to the World Health Organization (WHO), the activity of medicinal plants are not only limited to boosting flora, but also recognized for their medicinal value [26-29]. Antimicrobial, antioxidant, anticancer, hypolipidemic, cardiovascular, central nervous, respiratory, immunological, anti-inflammatory, analgesic antipyretic, and many other pharmacological actions were found in the plant [25, 30, 31].

Between 1983 and 1994, chemicals derived from natural products or semi-synthetic drugs derived from natural sources accounted for 78 percent of new drugs approved by the US Food and Drug Administration (FDA) [14, 32, 33]. According to a poll, the public's use of medicinal plants increased from 3 % in 1993 to over 37 % in 1998 [34, 35]. The low cost of herbal drugs, which endears them to the poor masses of the developing world, the 'green' movement in the developed world, which campaigns on the inherent safety and desirability of natural products; and the individualistic philosophy of western society, that further encourages self-medication, with many people preferring to treat themselves with phytomedicines, have all facilitated this shift to herbal drugs [10, 36, 37]. Dolichos is a genus of Papileonaceae family. In Nigeria, there are about 8 kinds, with *Dolichos biflorus* (*D. biflorus*) and *Dolichos lablab* (*D. lablab*) being the most widely cultivated and used [38]. Since antiquity, the plant has been far more popular in Nigeria and India than in any other country [39]. As a result, the purpose of this review was to describe the chemical compounds and antischistosomal activity of some Dolichos species currently reported.

2. Results and Discussion

2.1 Compounds isolated from Dolichos species

Mono and oligosaccharides (7.3%) were isolated from the endosperm of *Dolichos pachyrhizus* [40]. Fructose (**1**), galactose (**2**), glucose (**3**), sucrose (**4**), and raffinose (**5**) were recognized [41]. Six novel oleanane type triterpene bisdesmosides were recovered from the glycoside combination of *Dolichos pachyrhizus* seeds, together with chikusetsu saponin IV. *Dolichos pachyrhizus* var. lignosus (field bean) and *Dolichos pachyrhizus* var. typicus seeds were used to isolate two lectins (Pachyrhizus bean) [20]. Both lectins appeared to be formed up of four identical subunits and had a molecular weight of 60,000 (apparent molecular weight 15,000). The lectins' carbohydrate content was primarily fructose (2-5 moles per mol of protein) (**1**), mannose (5-8 mol per mol of protein) (**6**) and *N*-acetyl glucosamine (1-2 moles per mol of protein) (**7**). Both lectins have a comparable amino acid composition and a similar tryptic peptide map [42].

Both lectins have only alanine and serine as N and C-terminal amino acids. Low levels of bound metals such as manganese, magnesium, and calcium were identified in the lectins. The lectins' near-ultraviolet circular dichroism spectra were similar to sainfoin's [43]. Tyrosine and tryptophan residues were engaged in sugar binding, according to circular dichroism studies [44]. *Pachyrhizus pachyrhizus* contains a total of 262 volatile chemicals, volatile terpenes, and terpenoids, as well as their derivatives, dominated the volatile components, accounting for 46 % of all identified molecules [45]. The detected compounds were separated into 12 classes, namely alcohols (**28**), aldehydes (**10**), ketones (**19**), esters (**46**), acids (**7**), oxygen heterocycles (**1**), pyrazines (**5**), thiazoles (**4**), hydrocarbons (**57**), terpenes and terpenoids (**59**), phenols (**5**), and miscellaneous compounds [46]. The most common individual compounds were Isopentyl alcohol (**8**), 3,7,11-trimethylhentriacontane (**9**), (*E*)-2-octene (**10**), 7, 11, 17, 21-tetramethylhentriacontane/ 7, 11, 17, 25-tetramethylhentriacontane (**11**), 6-methyldotriacontane (**12**), norbornene (**13**), pentanol (**14**), 4-methylthiazole (**15**), 5,9,13-trimethylnonacosane (**16**), methylbutyrate (**17**), isopentylformate (**18**), 13,17-dimethylnonacosane (**19**), 13-methylhentriacontane (**20**), 9-methylhentriacontane (**21**), 7-methylhentriacontane (**22**), heptanal (**23**), 5-methylhentriacontane (**24**), 3, 11, 19-trimethylhentriacontane (**25**), and 3, 7-dimethylhentriacontane (**26**) [4]. Luteolin (**27**), luteolin-4'-O-D-glucopyranoside (**28**), and luteolin-7-0-beta-D-glucopyranoside (**29**) were found as flavonoids isolated from the flower of *Dolichos pachyrhizus* (**Table 1**) [35]. The rotenoid content of *Pachyrhizus purpureus* plant sections was investigated. The roots had the highest amount, while the seeds had the lowest [47].

2.2. Compounds isolated from Dolichos family

Studies have been carried out on some Dolichos species to identify the presence of several constituents. Having extensively studied the phytochemistry of Dolichos, different research groups have identified the following compounds from the root extract of *Neorautanenia mitis* [7]: Neodulene (**30**) [48], Neodulin (**31**), Ferullic acid (**32**) [49], Pachyrhizine (**33**), Neotenone (**34**), 12a-hydroxydolineon (**35**), Dolineon (**36**), Dehydroneotenone (**37**), [50], Ambonane (**38**) [51], Stigmasterole (**39**) [52], 7-methoxy-3-(6-methoxybenzo[*d*][1,3]dioxol-5-yl)chroman-4-one (**40**) [53], (-)-2-isopentenyl-3-hydroxy-8-9-methylenedioxypterocarpan (**41**) [54], Nepseudin (**42**) [55], Neorautenol (**43**) [56, 57], Isoneorautenol (**44**) [58], (-)-2-hydroxypterocarpin (**45**) [59], Rotenone (**46**), 12a-hydroxyrotenone **(47)** [60-61], Rautandiol A (**48**), and Rautandiol B (**49**) (**Table 2**) [49, 62].

2.3. Some compounds with antischistosomal activity

Studies were carried out from different plant species and assessed for the antischistosomal activity. In a study conducted by [63], the following compound were isolated and tested for their antimicrobial and antischistosomicidal activities from the leaves extracts of *E. camaldulensis*; Gallic acid (**50**), Taxifolin (**51**), Methyl gallate (**52**), Quercetin (**53**), Luteolin

Table 1. Compounds isolated from Dolichos species

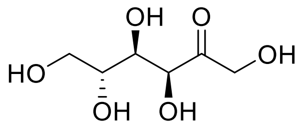
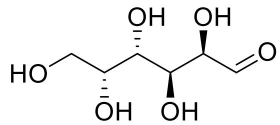
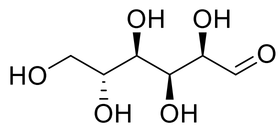
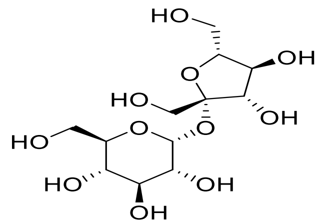
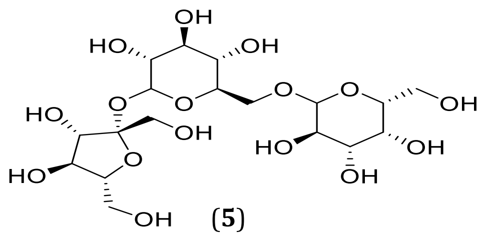
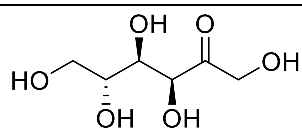
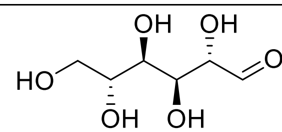
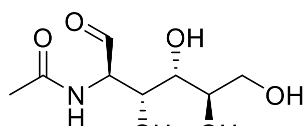
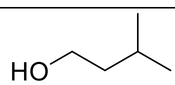
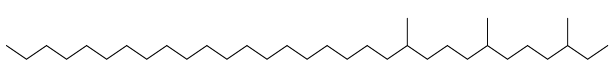
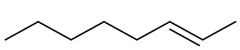
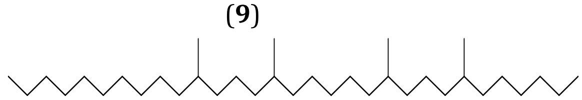
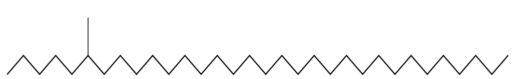
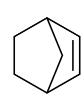
Botanical name	Name of compound	Reference
Dolichos pachyrhizus (endosperm)	 (**1**)  (**2**)  (**3**)  (**4**)  (**5**)	[41]
Dolichos pachyrhizus (seeds)	 (**1**)  (**6**)  (**7**)	[42]
Pachyrhizus pachyrhizus (seeds)	 (**8**)  (**9**)  (**10**)  (**11**)  (**12**)  (**13**)	[4]

Table 1. Continued

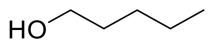
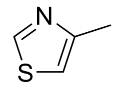
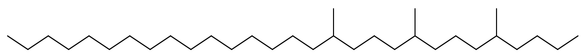
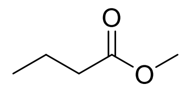
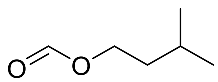
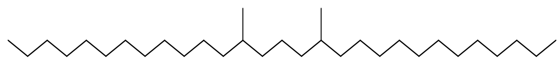
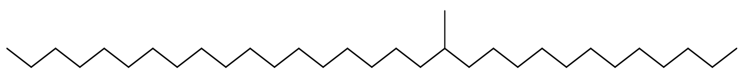
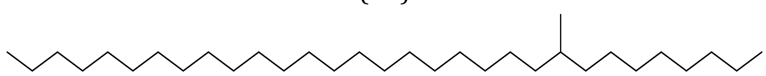
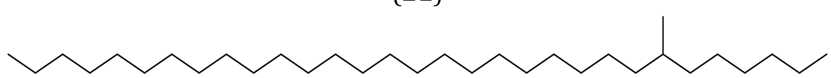
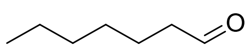
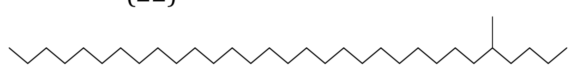
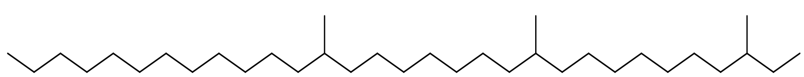
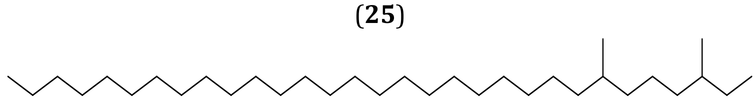
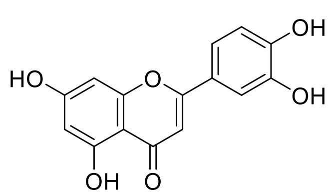
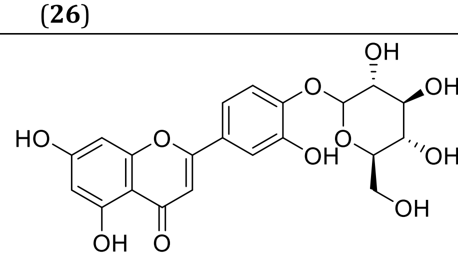
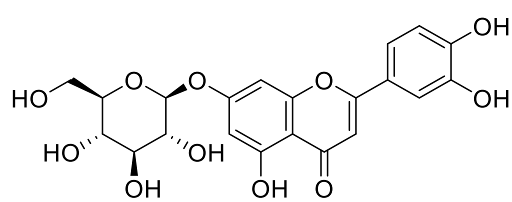
Pachyrhizus pachyrhizus (seeds)	 (**14**)  (**15**)  (**16**)  (**17**)  (**18**)  (**19**)  (**20**)  (**21**)  (**22**)  (**23**)  (**24**)  (**25**)  (**26**)	[4]
Dolichos pachyrhizus (flowers)	 (**27**)  (**28**)  (**29**)	[35];[47]

Table 2. Compounds isolated from Dolichos family

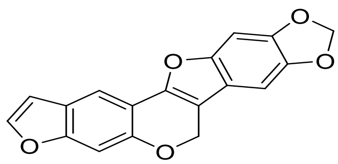
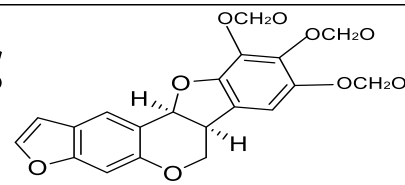
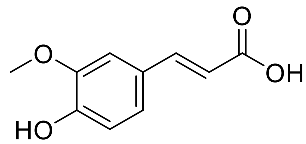
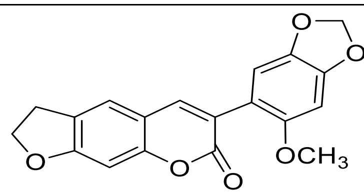
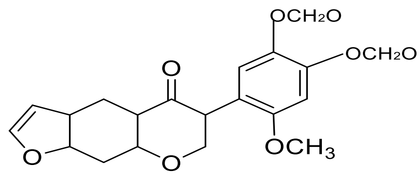
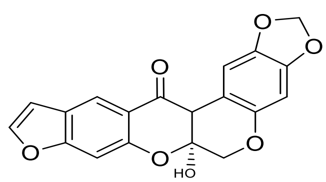
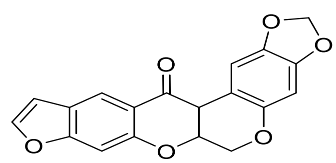
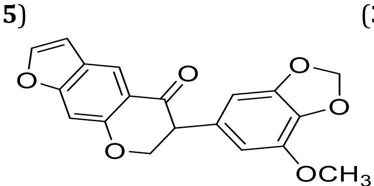
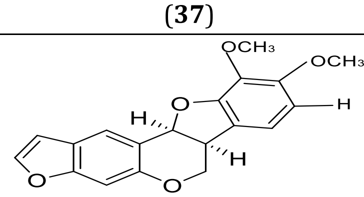
Botanical name	Name of compound	Reference
Neorautanenia mitis (root)	 **(30)**  **(31)**  **(32)**	[49]
Neorautanenia mitis (root)	 **(33)**  **(34)**  **(35)**  **(36)**  **(37)**	[50]
Neorautanenia mitis (root)	 **(38)**	[51]

Table 2. Continued

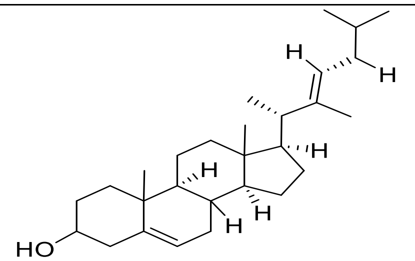
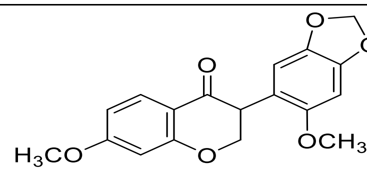
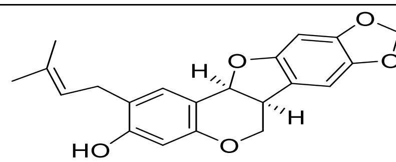
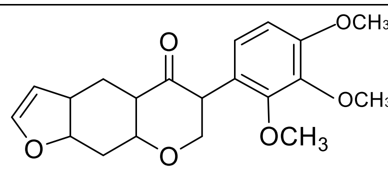
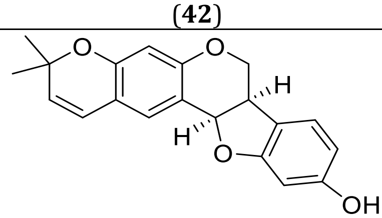
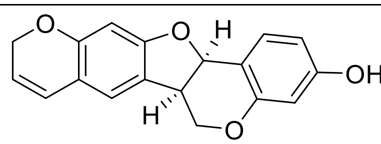
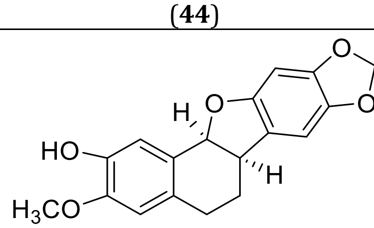
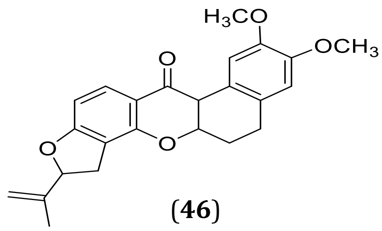
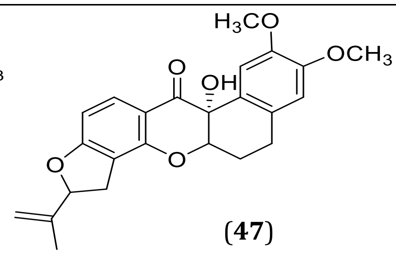
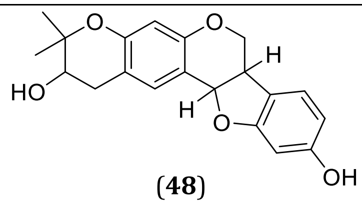
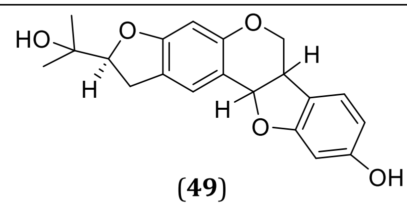
Neorautanenia mitis (root)	 (**39**)	[52]
Neorautanenia mitis (root)	 (**40**)	[53]
Neorautanenia mitis (root)	 (**41**)	[54]
Neorautanenia mitis (root)	 (**42**)	[55]
Neorautanenia mitis (root)	 (**43**)	[56-57]
Neorautanenia mitis (root)	 (**44**)	[58]
Neorautanenia mitis (root)	 (**45**)	[59]

Table 2. Continued

Neorautanenia mitis (root)	 (**46**)  (**47**)	[60-61]
Neorautanenia mitis (root)	 (**48**)  (**49**)	[49]

(**54**), and Hesperidin (**55**). A triterpenoid Asparagalin (**56**) was also isolated from *Asparagus stipularis* an African medicinal plant [64]. *In vitro* Antischistosomal activities of the extracts and compounds from *Solidago microglossa* DC (Asteraceae), *Aristolochia cymbifera* Mart., and Zucc. (Aristolochiaceae) were assessed and revealed the effectiveness of the following compounds against schistosomal larva; Bauerenol (**57**), alpha-amyrin (**58**), Spinasterol (**59**), Populifolic acid (**60**), Cubebin (**61**), 2-oxopopulifolic acid methyl ester (**62**), and 2-oxo populifolic axid (**63**) [65].

In a research conducted by [66], reported the isolation of thirty nine (39) compounds with antischistosomal activities including the terpenoids: Rotundifolone (**64**) [66-70], Limonine epoxide (**65**), and Carvacryl acetate (**66**) [71], Artemisinin (**67**) [66,69,72], Artemether (**68**), and Artesunate (**69**) [67-69,73-74], Dihydroartimisinin (**70**) [66,69,75-76], Nerolidol (**71**) [77], Budlein-A (**72**), Dihydrobudlein-A (**73**), and Tetrahydrobudlein-A (**74**) [78], Phytol (**75**) [79], Betulin (**76**) [80], Triphenylphosphonium salt of betulin (**77**) and (**78**) [81], Balsaminol F (**79**), and Karavilagenin C (**80**) [82]; the alkaloids: Piplartine (**81**) [83], Piperamide (**82**) [84], Epiisopiloturine (**83**) [85], Sanguinarine (**84**), Solamargine (**85**) and Solasanine (**86**) [86], Mefloquine (**87**) [87-88], and the phenolics: Plumbagin (**88**) [89-90], b-Lapachone (**89**) [91], Quarcetin-3-O-b-d-glucoside (**90**) Quarcetin-3-O-b-d-rhamnoside (**91**) [92], Kaempferol (**92**) [93], Sativan (**93**) [94], Hesperidin (**94**) [95], Licarin A (**95**) [96], Curcumin (**96**) [97-100], Aspidin a phloroglucinol derivative (**97**), Flavaspidic acid (**98**), Methylene-bis-aspidinol (**99**), and Desaspidin (**100**) (**Table 3**) [101].

Table 3. Some compounds with antischistosomal activity

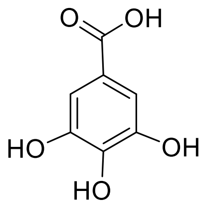
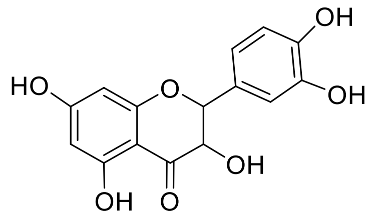
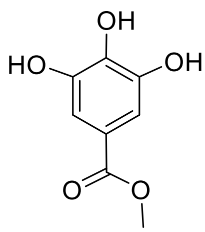
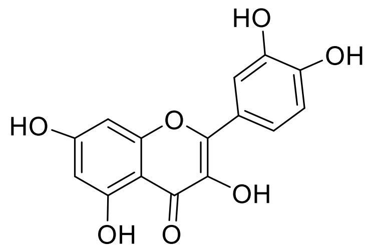
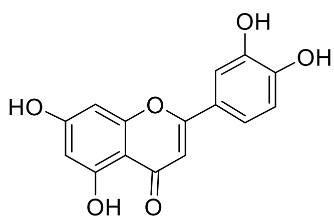
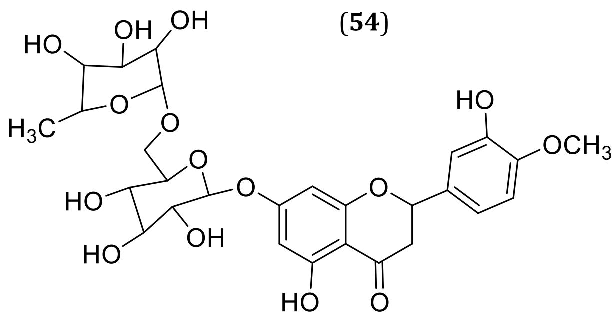
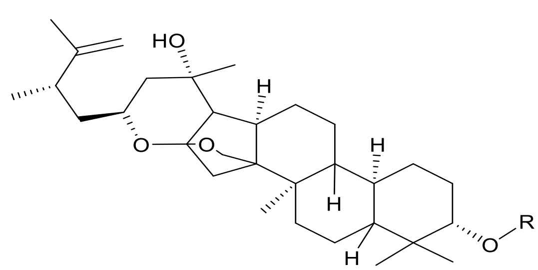
Botanical name	Name of compound	Reference
E. camaldulensis (leaves)	 (**50**)  (**51**)  (**52**)  (**53**)  (**54**)  (**55**)	[63]
Asparagus stipularis	 Asparagalin (**56**)	[64]

Table 3. Continued

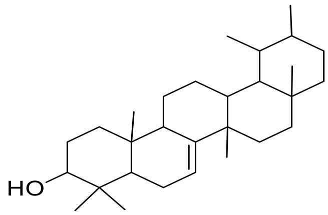
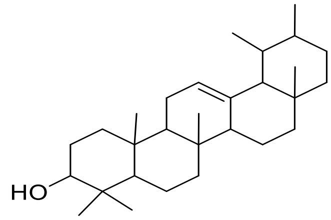
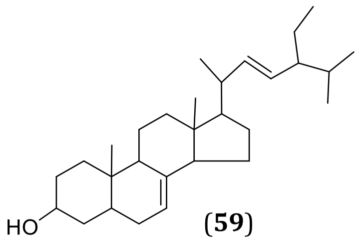
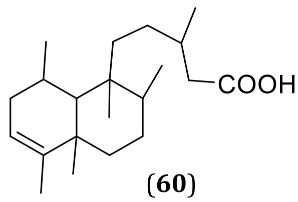
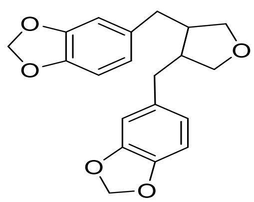
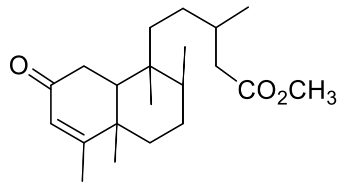
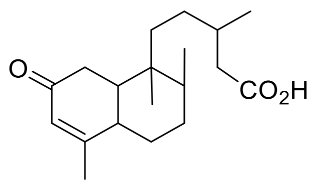
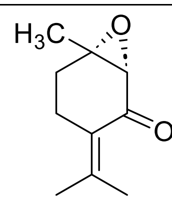
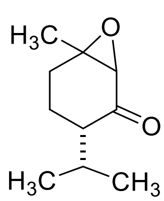
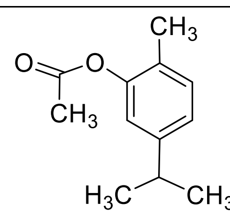
Solidago microglossa and *Aristolochia cymbifera* (extract)	 **(57)**  **(58)**  **(59)**  **(60)**  **(61)**  **(62)**  **(63)**	[65]
Menthax villosa	 **(64)**	[66-70]
Derived from many plants	 **(65)**  **(66)**	[71]

Table 3. Continued

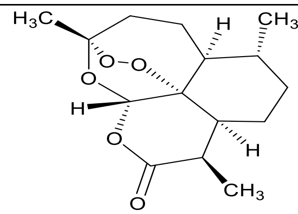
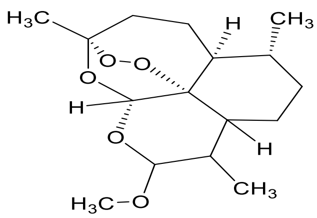
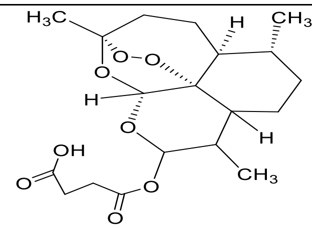
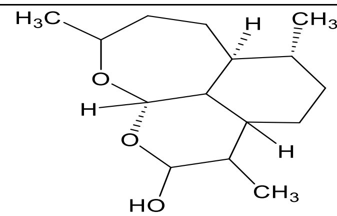
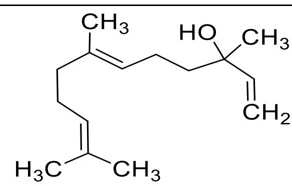
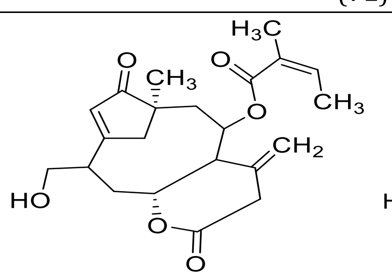
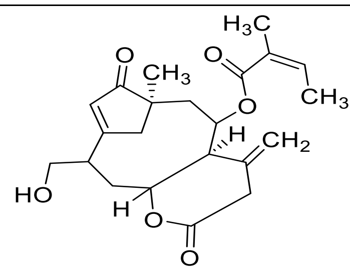
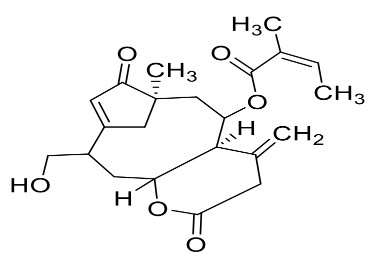
Artemisia annua L	 (**67**)	[66;69;72]
Derived from artemisinin	 (**68**)  (**69**)	[67-69] [73-74]
Derived from artemisinin	 (**70**)	[66];[69] [75-76]
Derived from many plants	 (**71**)	[77]
Artemisia annua L	 (**72**)  (**73**)  (**74**)	[78]

Table 3. Continued

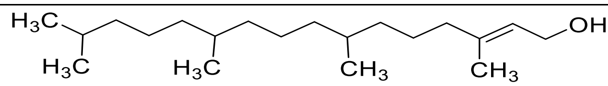
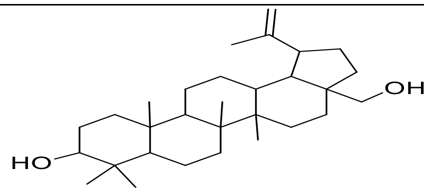
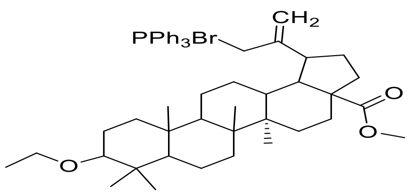
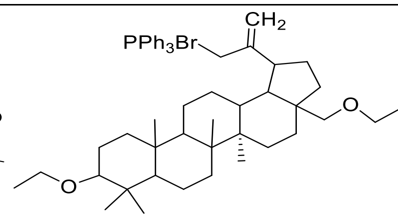
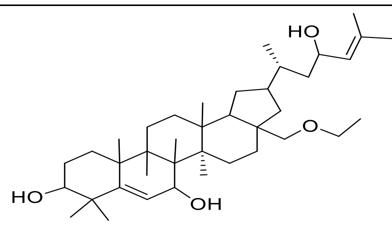
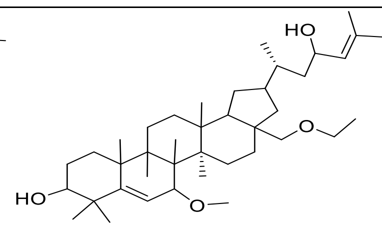
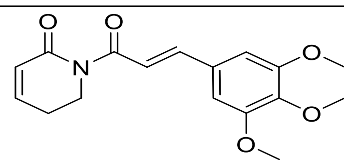
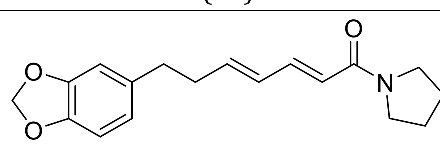
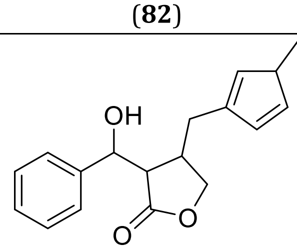
Derived from many plants	 **(75)**	[79]
Schefflera vinosa	 **(76)**	[80]
Derived from botulin	 **(77)**  **(78)**	[81]
Momordica balsamina L	 **(79)**  **(80)**	[82]
Piper tuberculatum	 **(81)**	[83]
Piper amalago L	 **(82)**	[84]
Pilocarpus microphyllus Stapf	 **(83)**	[85]

Table 3. Continued

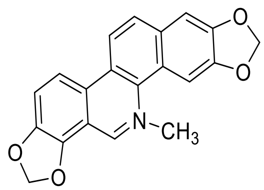
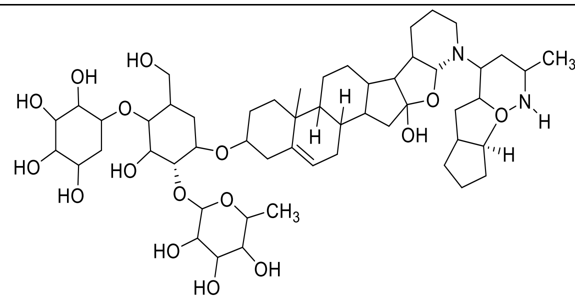
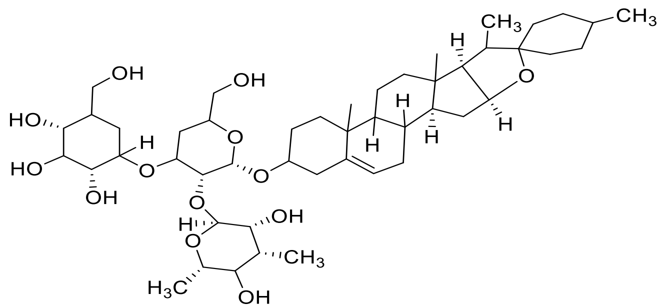
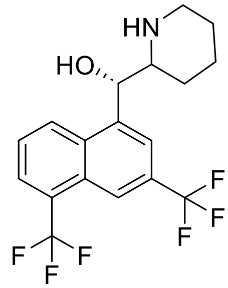
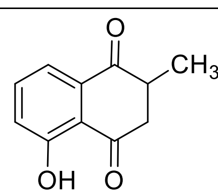
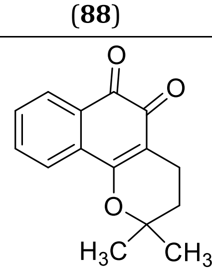
Sanguinaria spp	 (**84**)  (**85**)  (**86**)	[86]
Analogue of quinine	 (**87**)	[87-88]
Plumbago spp	 (**88**)	[89-90]
Derived from lapachol	 (**89**)	[91]

Table 3. Continued

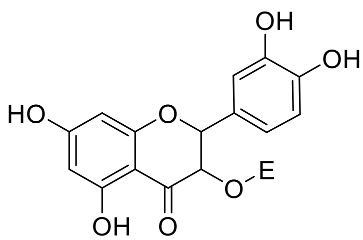
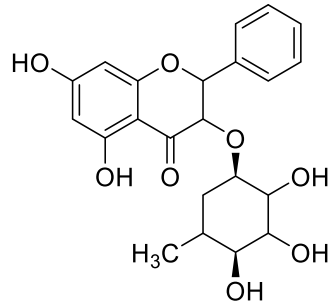
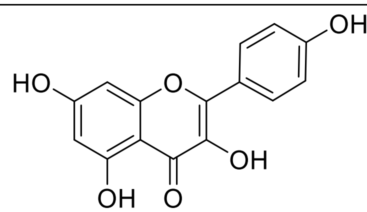
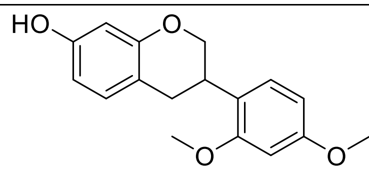
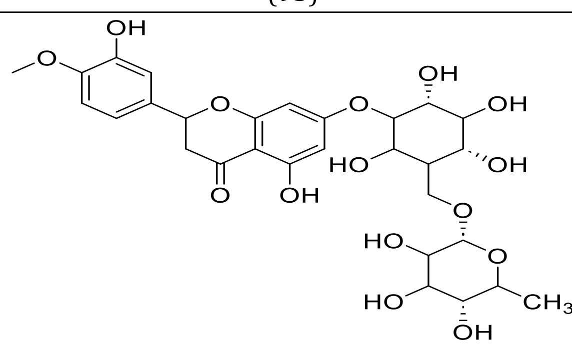
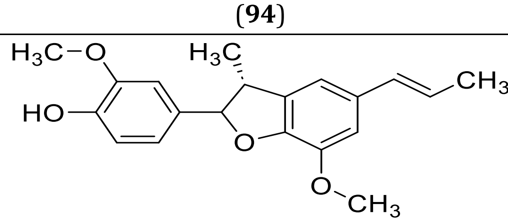
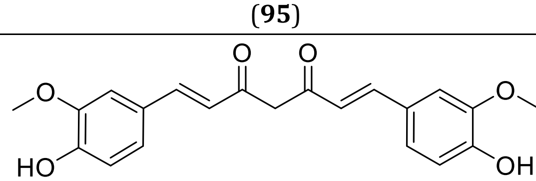
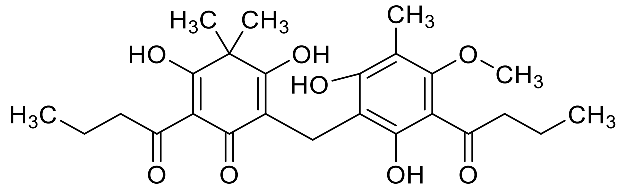
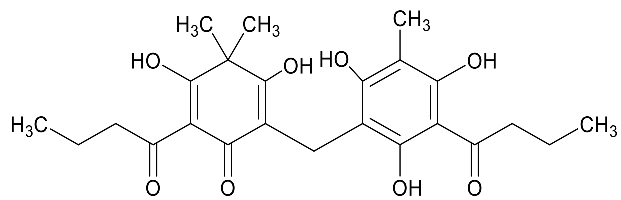
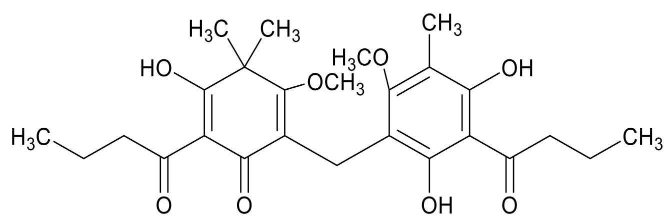
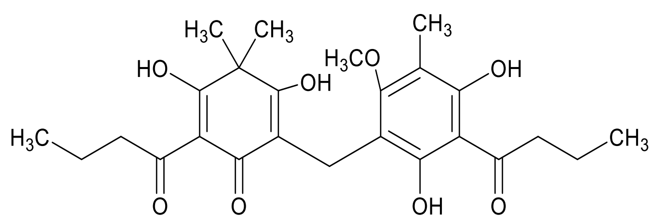
Roupala montana	 (**90**)  (**91**)	[92]
Styrax pohlii Pohl	 (**92**)	[93]
Astragalus englerianus Ulbr.	 (**93**)	[94]
Citrus fruits	 (**94**)	[95]
Many plants.	 (**95**)	[96]
Curcuma longa L.	 (**96**)	[95]; [97-100]

Table 3. Continued

Dryopteris genus	 (**97**)  (**98**)  (**99**)  (**100**)	[101]

3. Conclusion

The isolation of compounds from Dolichos species provides insights into their chemical composition and supports the exploration of their pharmacological activities. The identification of mono and oligosaccharides, triterpene bisdesmosides, and lectins from Dolichos species contributes to the understanding of their therapeutic potential. Further research is needed to fully elucidate the mechanisms of action and therapeutic potential of the isolated compounds. In addition, more studies are required to explore other Dolichos species and their bioactive constituents. The continued investigation of Dolichos species and their bioactive compounds may lead to the development of new drugs for the treatment of various ailments, including schistosomiasis.

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in one way or the other during the conduct of the research.

Conflict of interest

The authors declare that they have no competing interests.

Orcid:

Nasiru Malan Musa
https://orcid.org/0000-0002-4113-7228

Muhammad Sani Sallau
https://orcid.org/0000-0002-4113-7228

Adebayo Ojo Oyewale
https://orcid.org/0000-0002-4113-7228

Tijjani Ali
https://orcid.org/0000-0002-4113-7228

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