

## A Review on Naturally Occurring Steroids

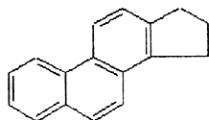
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(Received 30<sup>th</sup> November, 2004, revised 27<sup>th</sup> June, 2005)

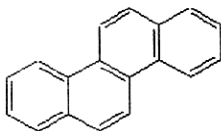
### Introduction

Plant and animal fats contain non-saponifiable portion. These substances, which are primarily solid alcohols, are known as sterols. Fundamental carbon skeleton of the sterol persists through a variety of interesting biologically important materials among which are the brain and spinal tissues, the constituents of bile, sex hormones and compounds related to vitamin D and other vitamins [1].

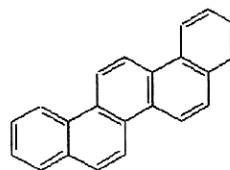
The structures of steroids are based on the 1:2 cyclopentenophenanthrene skeleton. All the steroids give, among other products, diel's hydrocarbon on dehydrogenation with selenium at 360°C. Distillation with selenium at 420°C, the steroids give mainly chrysene and a small amount of picene [2]. The structures of these compounds are as follows.



1:2 Cyclopentenophenanthrene



Chrysene



Picene

### List of steroids isolated from different plant species

Compd. No.	Name of the compound Molecular formula Molecular weight	Physical data	Source	Part	Ref.
1.	Campesterol C <sub>28</sub> H <sub>48</sub> O 401	M.P.: 157-58° [α] <sub>D</sub> <sup>23</sup> -33 (Chloroform)	<i>Temnopleurus toreumaticus</i> , <i>Melanolepsis multiglandulosa</i>	Roots	[8]
2.	β-sitosterol C <sub>29</sub> H <sub>50</sub> O 414	M.P.: 140° [α] <sub>D</sub> <sup>22</sup> -37 (c=2.0; Chloroform)	"	"	"
3.	Stigmasterol C <sub>29</sub> H <sub>48</sub> O 413	M.P.: 170° [α] <sub>D</sub> <sup>22</sup> -51 (c=2.0; Chloroform)	<i>Melanolepsis multiglandulosa</i>	"	[9]
4.	Stigmasterol-3-O-β-D-glucoside C <sub>35</sub> H <sub>58</sub> O <sub>6</sub> 574		"	"	"
5.	β-stigmasterol-3-O-β-D-glucoside C <sub>35</sub> H <sub>58</sub> O <sub>6</sub> 574		"	"	"
6.	Campesterol-3-O-β-D-glucoside C <sub>34</sub> H <sub>58</sub> O <sub>6</sub> 562	M.P.: 215-16°	"	"	"
7.	24-Vinyl cholesterol C <sub>29</sub> H <sub>49</sub> O 413	M.P.: 292-6°	"	"	"
8.	E-stigmast-5, 24(28)-dien-3β-ol C <sub>29</sub> H <sub>48</sub> O 412		<i>Mimusops elengi</i>	Aerial parts	[10]
9.	Z-stigmast-5, 24(28)-dien-3β-ol C <sub>29</sub> H <sub>48</sub> O 412		"	"	"

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## List of steroids isolated from different plant species

Compd. No.	Name of the compound Molecular formula Molecular weight	Physical data	Source	Part	Ref.
10.	Cholesterol C <sub>27</sub> H <sub>46</sub> O 386	M.P.: 148-5°	<i>Melanothamus somolensis</i>	"	[11]
11.	Somalenone C <sub>27</sub> H <sub>42</sub> O 382		"	"	"
12.	7-Oxo-cholesterol C <sub>27</sub> H <sub>44</sub> O <sub>2</sub> 400		"	"	"
13.	24-Methylene cholesterol C <sub>28</sub> H <sub>46</sub> O 398		"	"	"
14.	24-ethyl-cholest-5, 22, 25-trien-3β-ol C <sub>29</sub> H <sub>46</sub> O 411	M.P.: 201-3°	<i>Teucrium abutilosides</i> , <i>Teucrium betunicum</i>	"	[12]
15.	Clerosterol C <sub>29</sub> H <sub>48</sub> O 412		"	"	"
16.	Pariferasterol C <sub>29</sub> H <sub>48</sub> O 412		"	"	"
17.	Gitogenin C <sub>27</sub> H <sub>44</sub> O <sub>4</sub> 432	M.P.: 271-275° [α] <sub>D</sub> <sup>19</sup> -75° (c=1.2; CHCl <sub>3</sub> )	<i>Merenda persica</i>	Corns	[13]
18.	Ruscogenin C <sub>27</sub> H <sub>42</sub> O <sub>4</sub> 430	M.P.: 205-207° [α] <sub>D</sub> <sup>19</sup> -127°	"	"	"
19.	Diosgenin C <sub>27</sub> H <sub>42</sub> O <sub>3</sub> 414	M.P.: 204-207° [α] <sub>D</sub> <sup>25</sup> -129° (c=1.9; CHCl <sub>3</sub> )	"	"	"
20.	Fucosterol C <sub>29</sub> H <sub>48</sub> O 412	M.P.: 124° [α] <sub>D</sub> <sup>20</sup> -38.4° (CHCl <sub>3</sub> )	"	"	"
21.	Stigmastanol C <sub>29</sub> H <sub>52</sub> O 416	M.P.: 138-39° [α] <sub>D</sub> <sup>20</sup> -25° (c=1.0; CHCl <sub>3</sub> )	"	"	"
22.	Ecdysterone C <sub>29</sub> H <sub>44</sub> O <sub>7</sub> 504	M.P.: 240-41°	<i>Parazoanthus species</i>	Whole plant	[14]
23.	Ajugasterone C C <sub>29</sub> H <sub>44</sub> O <sub>6</sub> 488		"	"	"
24.	4-Dehydroecdysterone C <sub>29</sub> H <sub>42</sub> O <sub>7</sub> 502	M.P.: 272-73°	"	"	"
25.	Agaveside C C <sub>62</sub> H <sub>102</sub> O <sub>31</sub> 1342	M.P.: 256-60° [α] <sub>D</sub> <sup>25</sup> -39.4° (c=2.6; MeOH)	<i>Agave cantala</i>	Fruits	[15]
26.	DehydroxySpirosta-5, 22-dien C <sub>27</sub> H <sub>40</sub> O 380	M.P.: 223-25°	<i>Helleborus multifidus</i>	Roots	[16]
27.	DehydroxySpirosta-5, 22-dien-3, 11-diacetate C <sub>31</sub> H <sub>44</sub> O <sub>6</sub> 512	M.P.: 161-64°	"	"	"
28.	11α-hydroxy-24-S-ethyl-5α-cholest-22-en-3,6-dione C <sub>29</sub> H <sub>46</sub> O <sub>3</sub> 442	M.P.: 152-53°	<i>Pistia stratiotes</i>	"	[17]

## List of steroids isolated from different plant species

Compd. No.	Name of the compound Molecular formula Molecular weight	Physical data	Source	Part	Ref.
29.	Sceptrumgenin-3-O- $\beta$ -Dlycotetraside C <sub>50</sub> H <sub>92</sub> O <sub>22</sub> 1044	M.P.: 271-73° [ $\alpha$ ] <sub>D</sub> <sup>22</sup> -65.2° (c=0.3; DMSO)	<i>Polygonatum oriental</i> , <i>Senecio bonariensis</i> , <i>Yucco aloifolia</i>	Rhizomes, roots	[18-20]
30.	Spiroakryoside C <sub>51</sub> H <sub>78</sub> O <sub>24</sub> 1074	M.P.: 270-75° [ $\alpha$ ] <sub>D</sub> <sup>22</sup> -65.2° (c=0.35; DMSO)	"	"	"
31.	Veraminline-3-O- $\beta$ -glucopyranoside C <sub>33</sub> H <sub>55</sub> NO <sub>6</sub> 561	M.P.: 303-88° [ $\alpha$ ] <sub>D</sub> <sup>18</sup> -41.9° (c=0.6; MeOH)	<i>Veratrum taliense</i>	Hypogeeal parts	[21]
32.	Stenophylline-B-3-O- $\beta$ -D-glucopyranoside C <sub>33</sub> H <sub>55</sub> NO <sub>7</sub> 577	M.P.: 286-88° [ $\alpha$ ] <sub>D</sub> <sup>18</sup> -42.5° (c=0.1; MeOH)	"	"	"
33.	Cyclomicrobuxamine C <sub>24</sub> H <sub>37</sub> NO 355	M.P. 131-33° [ $\alpha$ ] <sub>D</sub> +106° (c=0.28)	<i>Buxus hildebrandtii</i>	Leaves	[22]
34.	Buxamine A C <sub>29</sub> H <sub>50</sub> NO <sub>2</sub> 444	[ $\alpha$ ] <sub>D</sub> +66°	"	"	"
35.	Buxamine C C <sub>28</sub> H <sub>48</sub> N 398	[ $\alpha$ ] <sub>D</sub> +22.4° (c=0.3)	"	"	"
36.	Moenjodaramin C <sub>28</sub> H <sub>46</sub> N <sub>2</sub> O 426	M.P. 158-60° [ $\alpha$ ] <sub>D</sub> +65° (c=0.2)	"	"	"
37.	Cyclorolfein	[ $\alpha$ ] <sub>D</sub> +48° (CHCl <sub>3</sub> )	"	"	"
38.	30-O-Benzoyl-16-deoxy buxidiamine-C C <sub>34</sub> H <sub>50</sub> N <sub>2</sub> O <sub>2</sub> 518	[ $\alpha$ ] <sub>D</sub> -75° (CHCl <sub>3</sub> )	"	"	"
39.	30-hydroxy buxamine A C <sub>28</sub> H <sub>48</sub> N <sub>2</sub> O 428	"	"	"	"
40.	30-Norbuxamine A C <sub>27</sub> H <sub>46</sub> N <sub>2</sub> 398	"	"	"	"
41.	Steroidal saponin 1 C <sub>50</sub> H <sub>80</sub> O <sub>23</sub> 1048	M.P. 278-80° [ $\alpha$ ] <sub>D</sub> <sup>12</sup> -67.7° (c=0.037; Pyridine)	<i>Chlorophytum malayense</i>	Rhizomes	[23]
42.	Steroidal saponin 2 C <sub>55</sub> H <sub>88</sub> O <sub>26</sub> 1164	M.P. 295-98° [ $\alpha$ ] <sub>D</sub> <sup>14</sup> -48.3° (c=0.058; Pyridine)	"	"	"
43.	Steroidal saponin 3 C <sub>55</sub> H <sub>90</sub> O <sub>25</sub> 1150	M.P. 290-93° [ $\alpha$ ] <sub>D</sub> <sup>23</sup> -21.6° (c=0.21; Pyridine)	"	"	"
44.	Steroidal saponin 4 C <sub>57</sub> H <sub>94</sub> O <sub>29</sub> 1242	M.P. 219-20° [ $\alpha$ ] <sub>D</sub> <sup>21</sup> -31.9° (c=0.512; Pyridine)	"	"	"
45.	$\alpha$ -Amyrin C <sub>30</sub> H <sub>50</sub> O 426	M.P. 186° [ $\alpha$ ] <sub>D</sub> <sup>17</sup> +91.6° (c=1.3; benzene)	<i>Teucrium chamacedryes</i>	Aerial partd	[24]
46.	$\beta$ -Amyrin C <sub>30</sub> H <sub>50</sub> O 426	M.P. 197° [ $\alpha$ ] <sub>D</sub> <sup>19</sup> +99.6° (c=1.3; benzene)	"	"	"
47.	3 $\beta$ -Hydroxystigmast-24, 25-dien-24-al C <sub>29</sub> H <sub>46</sub> O <sub>2</sub> 426	"	"	"	"
48.	Cyathisterol C <sub>28</sub> H <sub>42</sub> O <sub>2</sub> 410	"	<i>Calvitia cyathiformis</i>	Fruits	[25]

## List of steroids isolated from different plant species

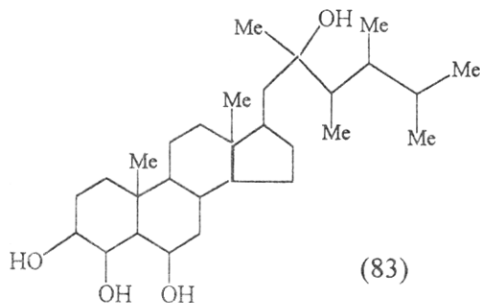
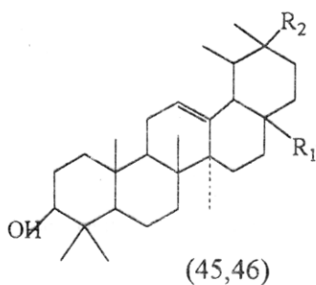
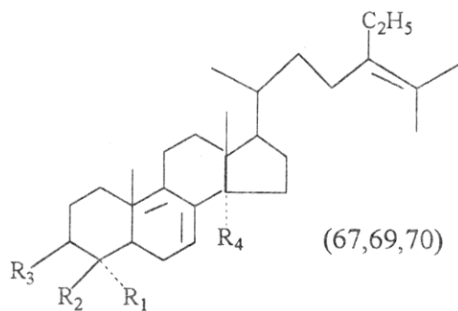
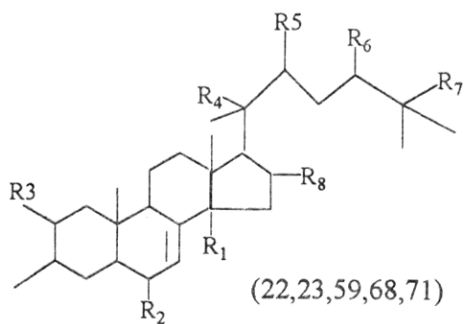
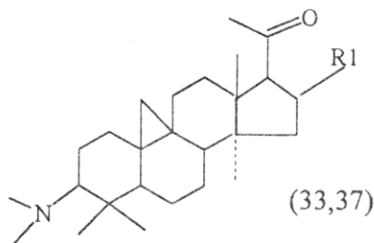
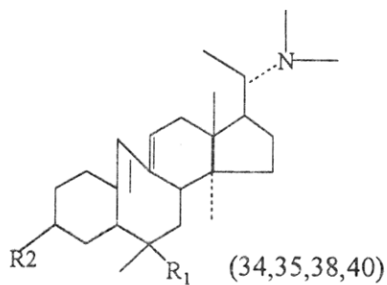
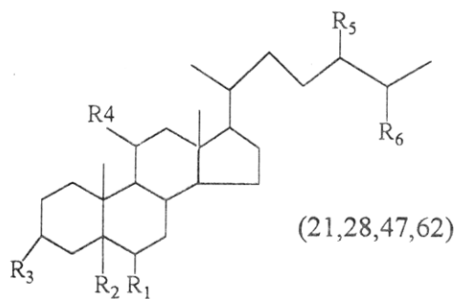
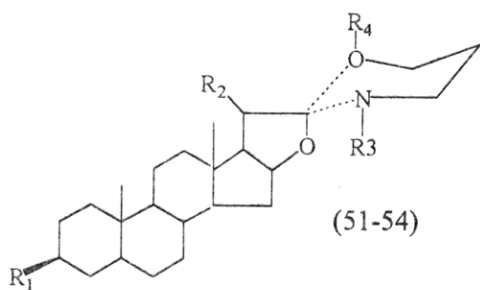
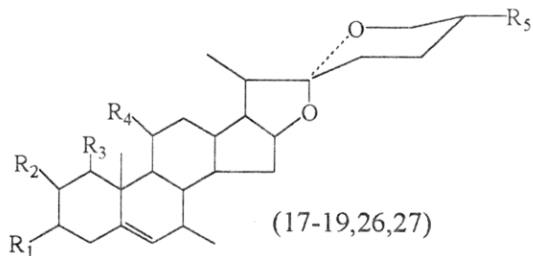
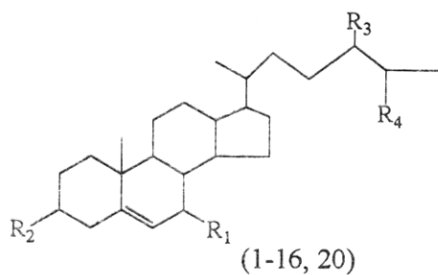
Compd. No.	Name of the compound Molecular formula Molecular weight	Physical data	Source	Part	Ref.
49.	Dehydrated cyathisterol C <sub>28</sub> H <sub>40</sub> O 392	[α] <sub>D</sub> <sup>25</sup> +50.4° (c=0.02; CHCl <sub>3</sub> )	"	"	"
50.	Tomatidine C <sub>27</sub> H <sub>45</sub> NO <sub>2</sub> 415	M.P. 210° [α] <sub>D</sub> <sup>20</sup> +4.9° (c=0.36; CHCl <sub>3</sub> )	Tomato stock	Roots	[26]
51.	5α-Tomatidan-3-one C <sub>27</sub> H <sub>43</sub> NO <sub>2</sub> 413	M.P. 195-98° [α] <sub>D</sub> <sup>20</sup> +19° (c=0.38; CHCl <sub>3</sub> )	"	"	"
52.	(23R)-23-Acetoxyomatidine C <sub>29</sub> H <sub>47</sub> NO <sub>4</sub> 473	[α] <sub>D</sub> <sup>20</sup> -2.8° (c=0.42; CHCl <sub>3</sub> )	"	"	"
53.	(23S)-23-Acetoxyoladulcidine C <sub>29</sub> H <sub>47</sub> NO <sub>4</sub> 473	[α] <sub>D</sub> <sup>20</sup> -46° (c=0.37; CHCl <sub>3</sub> )	"	"	"
54.	23-Acetoxy-N-spirosolan-3β-ol C <sub>29</sub> H <sub>47</sub> NO <sub>4</sub> 473	[α] <sub>D</sub> <sup>20</sup> -36.7° (c=1.2; CHCl <sub>3</sub> )	"	"	"
55.	Epimino-23-epoxy-23α-ethoxy-cholest-22-ene-3β,20α-diol C <sub>29</sub> H <sub>47</sub> NO <sub>4</sub> 473	[α] <sub>D</sub> <sup>20</sup> -38.3° (c=1.2; CHCl <sub>3</sub> )	"	"	"
56.	Epimino-23-epoxy cholest-3β,23α-diol C <sub>27</sub> H <sub>45</sub> NO <sub>3</sub> 431	M.P. 215-19° [α] <sub>D</sub> <sup>20</sup> +2.0° (c=0.81; EtOH)	"	"	"
57.	Methyl epimino-23-epoxy-25α-cholest-3β,23α-diol C <sub>28</sub> H <sub>47</sub> NO <sub>3</sub> 445	[α] <sub>D</sub> <sup>20</sup> -27.7° (c=0.63; CHCl <sub>3</sub> )	"	"	"
58.	20,24,25-trihydroxy ergost-7,22-dione C <sub>28</sub> H <sub>44</sub> NO <sub>7</sub> 506	M.P. 254-56° [α] <sub>D</sub> <sup>23</sup> +171° (c=0.41; MeOH)	<i>Lasiophaera nipponica</i>	Fruits	[27]
59.	Ergosterol peroxide C <sub>28</sub> H <sub>44</sub> O <sub>3</sub> 428	M.P. 180-81° [α] <sub>D</sub> <sup>23</sup> +59° (c=0.2; CHCl <sub>3</sub> )	"	"	"
60.	Ergosterol C <sub>28</sub> H <sub>44</sub> O 396	M.P. 160-62° [α] <sub>D</sub> <sup>23</sup> +106° (c=0.2; CHCl <sub>3</sub> )	"	"	"
61.	Cerevisterol C <sub>28</sub> H <sub>46</sub> O <sub>3</sub> 430	M.P. 234-36°	"	"	"
62.	Ergostanol C <sub>28</sub> H <sub>50</sub> O 403	M.P. 144-45°	"	"	"
63.	Lanosterol C <sub>30</sub> H <sub>50</sub> O 426	M.P. 138-40°	<i>Lasiophaera bryoniaidoidica</i>	Roots	[28]
64.	24-ethyl-29-nor-5α-lanost-7,24-dien-3β-ol C <sub>32</sub> H <sub>54</sub> O 454		"	"	"
65.	24-ethyl-29-nor-5α-lanost-11, 24-dien-3β-ol, C <sub>32</sub> H <sub>54</sub> O 454		"	"	"
66.	24-ethyl-29-nor-5α-lanost-7, 11, 24-dien-3β-ol C <sub>32</sub> H <sub>52</sub> O 452	M.P. 198-200°	"	"	"

## List of steroids isolated from different plant species

Compd. No.	Name of the compound Molecular formula Molecular weight	Physical data	Source	Part	Ref.
67.	5 $\alpha$ -Stigmast-7, 22, 24-trien-3 $\beta$ -ol C <sub>29</sub> H <sub>46</sub> O 410	M.P. 225-27°	"	"	"
68.	5 $\alpha$ -Stigmast-7, 9-dien-3 $\beta$ -ol C <sub>29</sub> H <sub>48</sub> O 412		"	"	"
69.	5 $\alpha$ -Stigmast-7, 9,24-trien -3 $\beta$ -ol C <sub>29</sub> H <sub>46</sub> O 410		"	"	"
70.	14 $\alpha$ -methyl-5 $\alpha$ Stigmast-7, 24-dien-3 $\beta$ -ol C <sub>30</sub> H <sub>50</sub> O 426		"	"	"
71.	Ecdysone C <sub>27</sub> H <sub>44</sub> O <sub>6</sub> 464		<i>Ajuga reptans</i> <i>Ajuga incisia</i>	Aerial parts	[29]
72.	20-Hydroxy ecdysone C <sub>27</sub> H <sub>44</sub> O <sub>7</sub> 480		"	"	"
73.	Polypondine C <sub>27</sub> H <sub>44</sub> O <sub>8</sub> 496		"	"	"
74.	Cyasterone C <sub>29</sub> H <sub>44</sub> O <sub>8</sub> 520	M.P. 164-66° [ $\alpha$ ] <sub>D</sub> +64.5° (c=1.0; H <sub>2</sub> O)			
75.	29-Norcysterone C <sub>28</sub> H <sub>42</sub> O <sub>9</sub> 522		"	"	"
76.	29-Norsengosterone C <sub>28</sub> H <sub>42</sub> O <sub>9</sub> 522		"	"	"
77.	Ajugalactone C <sub>29</sub> H <sub>40</sub> O <sub>8</sub> 516		"	"	"
78.	22-Oxocysterone C <sub>29</sub> H <sub>42</sub> O <sub>8</sub> 518		<i>Ajuga nipponensis</i>	Stem & leaves	[30]
79.	24, 25-Dehydroprecysterone C <sub>29</sub> H <sub>42</sub> O <sub>8</sub> 518		"	"	"
80.	Sengosterone C <sub>29</sub> H <sub>44</sub> O <sub>9</sub> 536	[ $\alpha$ ] <sub>D</sub> -47.5° (c=1.0; CHCl <sub>3</sub> )	<i>Ajuga reptans</i> <i>Ajuga incisia</i>	Aerial parts	[31]
81.	Ajugasterone -A C <sub>20</sub> H <sub>42</sub> O <sub>7</sub> 394		"	"	[31-34]

Different plant species are rich source of steroids and their extracts have long been used in folk medicines. For example, *Acaena splendens* has been used in Chilean traditional medicine for the treatment of fever and inflammation. The aqueous methanol and dichloromethane extracts showed marked antipyretic and anti-inflammatory activities [3]. Phytoecdysones have been reported as insect inhibitors and feeding deterrents. Ponasterone A

strongly inhibits the growth and ecdysis of *Pectinophora gossypiella* and *Bombyx mori* larvae [4]. Anabolic-androgenic steroids have shown increase in the m-RNA level of  $\alpha$ -calcitonin gene-related peptide and choline acetyl transferase in rat lumber spinal cord motor neurons [5]. Steroidal antiandrogens are used in endocrine treatment regarding prostate cancer therapy with androgen inhibitors [6]. Previously, fifteen adult cancer



Some of the naturally occurring steroids

## Legends:

Comp d. No.	R <sub>1</sub>	R <sub>2</sub>	R <sub>3</sub>	R <sub>4</sub>	R <sub>5</sub>	R <sub>6</sub>	R <sub>7</sub>	R <sub>8</sub>
1.	H	OH	Me	Me				
2.	H	OH	Ethyl (C <sub>22</sub> -C <sub>23</sub> )	Me				
3.	H	OH	Ethyl (C <sub>22</sub> -C <sub>23</sub> )	Me				
4.	H	O-Glc	Ethyl (C <sub>22</sub> -C <sub>23</sub> )	Me				
5.	H	O-Glc	Ethyl	Me				
6.	H	O-Glc	Me	Me				
7.	H	OH	Vinyl	Me				
8.	H	OH	H(C <sub>24</sub> -C <sub>25</sub> ), E	Me				
9.	H	OH	H(C <sub>24</sub> -C <sub>25</sub> ), Z	Me				
10.	H	OH	H	Me				
11.	=O	=O	H	Me				
12.	=O	OH	H	Me				
13.	H	OH	=CH <sub>2</sub>	Me				
14.	H	OH	Ethyl (C <sub>22</sub> -C <sub>23</sub> )	CH <sub>2</sub>				
15.	H	OH	Ethyl	Me				
16.	H	OH	H (C <sub>22</sub> -C <sub>23</sub> )	Me				
17.	OH	OH	H	H	Me			
18.	OH	H	OH	H	Me			
19.	OH	H	H	H	Me			
20.	H	OH	CHCH <sub>3</sub>	Me				
21.	H	H	OH	H	Ethyl	Me		
22.	OH	=O	OH	OH	OH	H	OH	H
23.	OH	=O	OH	OH	OH	H	H	H
24.	OH	H	H	OH	=CH <sub>2</sub>			
25.	OAc	H	H	Oac	=CH <sub>2</sub>			
26.	=O	H	=O	OH	Ethyl	Me		
27.	Me							
28.	Me	N(CH <sub>3</sub> ) <sub>2</sub>						
29.	Me	NHCH <sub>3</sub>						
30.	OH							
31.	CH <sub>2</sub> OCoph	NHCH <sub>3</sub>						
32.	CH <sub>2</sub> OH	N(CH <sub>3</sub> ) <sub>2</sub>						
33.	H	N(CH <sub>3</sub> ) <sub>2</sub>						
34.	COOH	H						
35.	Me	Me						
36.	H	H	OH	H	C <sub>2</sub> H <sub>2</sub> O	=CH <sub>2</sub>		
37.	OH	Me	H	H				
38.	=O	Me	H	H				
39.	OH	Me	H	OAc				
40.	OH	Me	OAc	H				
41.	OH	=O	H	OH	H	OH	OH	OH
42.	OH	OH	OH	H	Me	H(C <sub>22</sub> -C <sub>23</sub> )		
43.	Me	Me	H	Me				
44.	H	H	H	H	H	Ethyl		H(C <sub>24</sub> -C <sub>25</sub> )
45.	H	H	OH	H				
46.	H	H	OH	H(C <sub>22</sub> -C <sub>23</sub> )				
47.	Me	H	H	H	H	Ethyl		H(C <sub>24</sub> -C <sub>25</sub> )

patients were evaluated in order to determine the frequency and time course of steroid myopathy with adrenocorticosteroid [7].

Owing to the increasing number, greater medicinal and economic importance, this paper reviews the steroids isolated from different plants during the period 1991-2000 which have been presented in the table.

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