**PHYTOCHEMISTRY OF *CASSIA AURICULATA* (L.): A REVIEW**

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**ABSTRACT**

Natural product from many medicinal plants are obtained either as a pure compound or in the form of mixture from various standardized extracts of plants which provides unlimited opportunities for the development of new drug. *Cassia auriculata* Linn is one of the common plant in Asia, used in Ayurveda and the literature survey of this plant revealed the presence of preliminary phytochemical constituents such as alkaloids, phenolics, glycosides, flavonoids,

tannins, saponins, proteins, carbohydrates and anthroquinone derivatives and they all are responsible for the potent pharmacological activities. The plant has been reported to possess an antipyretic, hepatoprotective, antidiabetic, antiperoxidative and antihyperglycemic and microbicidal activities. The phytopharmacological review on *Cassia auriculata* plant has combining from the electronic databases such as scopus, Google scholar, NOPR, pubmed, Medline plus & Web of science, also from scientific journals, periodicals.

**KEYWORDS:** Phytochemical, Pharmacology, flavonoids etc.

**INTRODUCTION**

*Cassia auriculata* L. is known as "Avaram" in Tamil & commonly known as Tarners Cassia. It is a shrub belongs to Caesalpiniaceae family. Various part of the *Cassia auriculata* have the potential to treat many diseases and thus the plant has been reported to possess

Antimicrobial (Senthilkumar *et al.*, 2011), antidibetic (Daisy P *et al.*, 2012), Antioxidant (Senthil *et al.*, 2014), anticancer (Esakkirajan *et al.*, 2014), wound haealing activity (Lalitha *et al.*, 2014), anti-inflammatory (Manogaram *et al.*, 2004) and antiulcer activity (Mohammad *et al.*, 2010) These therapeutic activity of the plant may be due to the presence of preliminary phytoconstituents. The aim of the present review was to provide the information about pharmacological study and spectral data of major secondary metabolites of the different parts of the plant.

## PHARMACOLOGY

### Antimicrobial activity

Senthilkumar *et al.* (2011) reported the antimicrobial activity of Oleonic acid which was isolated from methanolic extract of leaves of *Cassia auriculata*. The different solvent extracts of the leaf of *Cassia auriculata* possess antimicrobial activity conducted by using well diffusion disc method against pathogenic microorganisms such as *Bacillus cereus*, *Staphylococcus aureus*, *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa* and *Proteus mirabilis*. Methanol and chloroform extracts exhibited strong inhibitory activity against all the tested organisms, except *Pseudomonas aeruginosa*.(Murugan T *et al.*,2013)

### Antidiabetic activity

Daisy P *et al.* (2012) investigated that the various extracts (hexane, ethyl acetate, methanol and aqueous) of *Cassia auriculata* bark were found to have potent antidiabetic activity that reduces blood sugar level in streptozotocin-(STZ) induced diabetic rats. In this investigation methanol extract was found to be more active. The increased level of insulin and C-peptide in *Cassia auriculata* extract may be due to the activation of remnant  $\beta$ -cells in the pancreas.

### Antioxidant activity

Senthil *et al.* (2014) studied methanol extract of *Cassia auriculata* flower in which they revealed the presence of phenol and flavonoids. The presence of the phenol and flavonoids in methanol extract of *Cassia auriculata* showed the potent antioxidant activity.

### Anticancer Activity

Esakkirajan *et al.* (2014) studied 4-(4- chlorobenzyl)-2, 3, 4, 5, 6, 7-hexahydro-7-(2-ethoxyphenyl)benzo[h] triazecin (1H)-one compound which was isolated from ethanol extract of *Cassia auriculata* leaves that inhibits the growth of human colon cancer cells.

### Wound Healing activity

Lalitha et al. (2014) investigated the wound Healing activity of ethanol and aqueous extracts of *Cassia auriculata* flowers. To study the wound healing potency of extract they used chick embryo wound model and this model showed the ethanol extract having good healing potency than aqueous extracts. Wound healing potential of *cassia auriculata* flowers extract may be due to the presence of phenolic compound, tannin & flavonoids.

#### **Anti-inflammatory activity**

Manogaram et al. (2004) reported the 50% acetone extract of the flower of *cassia auriculata* showed marked anti-inflammatory activity (56%) in carrageenin induced oedema in rats. It may be due to the presence of flavonol glycoside (5-O-methylquercetin 7-O-glucoside) which was isolated from *Cassia auriculata* flowers.

#### **Antiulcer activity**

Mohamad et al. (2010) reported the anti-ulcer activity of *cassia auriculata* leaf extract against pylorous ligation induced gastric ulcer. The methanol leaf extract of this plant at dose of 300 mg/kg p.o. markedly decrease the incidence of ulcers in pyloric ligatied rats. The antiulcer activity may be due to the presence of phytochemical constituent like tannin & flavonoids.

### **PHYTOCHEMISTRY**

The *Cassia auriculata* plant exhibit the presence of various phytoconstituents of different family viz., alkaloids, flavanoids, tannins, saponins, steroids, glycosides. Among various classes the oleanolic acid is act as an antibacterial agent and it was isolated from methanol extract of *Cassia auriculata* leaves, it inhibit the different pathogenic bacteria. The 3,6,8-trihydroxy-2-(3,4 dihydroxyphenyl)-4H- chromen-4-one is a bioactive compound isolated from ethanolic extracts of leaves of this plant. The 4-(4chlorobenzyl)2,3,4,5,6,7-hexahydroxy-7-(2-ethoxyphenyl)benzol was isolated from leaves of CA & this comp had a great potential to prevent colon cancer cell line HCT-15. Also the diethyl phthalate in the form of thick viscous oil which was isolated from CA plant. Di-(2-ethyl)-hexylphthalate compound was isolated from CA leaves. The emodin substituted anthroquinone was isolated from the fresh leaves of CA. The UV, IR, <sup>1</sup>HNMR, <sup>13</sup>CMR & MS spectral data of said chemical constituent & their chemical structures are mentioned in this review.

#### **1. Avrol-I (SeikouNakamura et. al ., 2014)**

Molecular Formula:  $C_{30}H_{26}O_9$

UV ( $\lambda_{max}$ , nm): 281, 230, 274, 239.

IR (KBr  $cm^{-1}$ ): 3430, 1509.

$^1H$ NMR (acetone- $d_6$ , 500MHz): 1.89, 2.10, (1H each, both m, H2-3''), 2.28 (1H, m, H-3a), 2.55 (1H, m, H-3 $\beta$ ), 2.61 (2H, m, H2-4''), 4.51 (1H, dd like H-4 $\alpha$ ), 4.75 (1H, dd, J=2.2, 10.1, H''), 5.38 (1H, dd, J=3.4, 6.4, H-2), 6.01 (1H, s, H-6''), 6.33 (1H, dd, J=2.5, 8.6Hz, H-6) 6.43(1H, d, J=2.5Hz, H-8), 6.49 (2H, s, H-2''',6'''), 6.76 (d, J=8.6 Hz, H-5), 6.81 (2H, J=8.6Hz, H-3',5'), 7.22 (2H, d, J=8.6Hz, H-2'6').

$^{13}C$ NMR ( $\delta$  acetone- $d_6$ ): 76.1(C-2), 35.5(C-3), 28.9 (C-4), 130.4(C -5), 109.3 (C-6), 157.5(C-7), 104.1(C-8), 156.7(C-9), 155.9(C-10), 133.90(C-1'), 127.9(C-2',6'), 115.9(C-3',5'), 158.0 (C-4'), 77.9(C-2''), 30.3(C-3''), 20.3(C-4''), 155.5(C -5''), 96.8(C-6''), 154.9(C-7''), 110.8(C-8''), 155.7( C-9''), 102.8(C-10''), 134.2(C-1'''), 106.1( C-2''',6'''), 146.5( C-3''',5'''), 133(C-4''').

EI-MS (FAB-MS m/z): 553 [ $M^+$ ].

## 2. Avaraoside I (Seikou Nakamura *et. al.*, 2014)

UV (MeOH  $\lambda_{max}$ ): 327, 292, 235.

IR (KBr  $cm^{-1}$ ): 3423, 1717, 1619, 1509, 1069.

$^1H$  NMR(acetone- $d_6$ , 600 MHz): 2.79(3H,s,CH<sub>3</sub>-5), 4.79(1H, br s, H-1''), 5.38 (1H, d, J=7,3Hz, H-1), 6.03 (1H, s, H-3), 6.64 (1H, d, J=2Hz, H-9), 6.75 (1H, d, J=2Hz, H-7), 7.30 (1H, s, H-6).

$^{13}C$ NMR ( $\delta$  acetone-  $d_6$ ): 163.0 (C-2), 91.2 (C-3), 169.4 (C-4), 108.5 (C-4a), 133.5(C -5), 126.2 (C-6), 139.2 (C-6a), 102.6 (C-7), 160.3 (C-8), 104.1 (C-9), 156.7 (C-10), 106.8 (C-10a), 154.8 (C-10b), 100(C-1'), 73.9 (C-2'), 77.0 (C-3'), 70.6 (C-4'), 77.6 (C -5'), 67.2(C-6'), 101.5 (C-1''),71.8 (C-2''),71.4 (C-3''), 73.2 (C-4''),69.4 (C -5''), 17.9 (C-6'').

EI-MS (FABMS): [ $M+H$ ]<sup>+</sup> 567.

## 3. Oleanolic acid (Vaishali D.Murade. *et al.*, 2015)

Molecular formula:  $C_{30}H_{48}O_3$

UV ( $\lambda_{max}$  EtOH nm): 277.

IR (KBr)  $cm^{-1}$ : 3466-3534, 1694.

$^1H$ NMR (CDCl<sub>3</sub>, 500MHz): 0.75, 0.77, 0.90, 0.91, 0.93, 0.98 (each 3H, s, CH<sub>3</sub> $\times_6$ ), 1.13 (3H, s, H-27), 2.82 (11t, dd, J=3.6Hz & 13.2Hz, H-18), 3.23 (11t, dd, J= 11.2 Hz & 4.4 Hz, H-3), 5.27 (1H, t, J =3.5 Hz, H-12).

<sup>13</sup>C NMR(δ Pyridine- d<sub>5</sub>,125 MHz): 39.0 (C-1), 28.2 (C-2), 78.1 (C-3), 39.4 (C-4), 55.8 (C-5), 18.8 (C-6), 33.3 (C-7), 39.8 (C-8), 48.2 (C-9), 37.4 (C-10), 23.7 (C-11), 122.6 (C-12), 144.8 (C-13), 42.2(C-14), 28.4 (C-15), 23.8(C-16), 46.7(C-17), 42.0(C-18), 46.5(C-19), 31.0(C-20), 34.3(C-21), 33.2 (C-22), 28.8(C-23), 16.6(C-24)15.6(C-25), 17.5(C-26), 26.2(C-27), 180.2(C-28), 33.3(C-29\ 20), 23.8 (C-30)

MS (m/z): 320, 306, 279, 203, 289, 173, 159, 147, 129, 119, 105, 95, 81.

#### 4. Di (2-ethyl hexyl) phthalate (Nageswara et al., 2000)

Molecular formula: C<sub>24</sub> H<sub>38</sub> O<sub>4</sub>.

UV (λ<sub>max</sub>, nm): 246.2, 273.4.

IR (KBr cm<sup>-1</sup>): 1739 (C = O), 1047 – 1250 (C-O)

<sup>1</sup>H NMR ( δ CDCl<sub>3</sub> , 300MHz ): 0.91 (t, J=6.6 Hz, 6-H, 2''-H ), 1.20-1.50 (m, 2-H, 3-H, 4-H & 5-H merged), 1.60-1.70 (q, 2H, 2-H ), 4.20 (dd like, 2H, 1-H), 7.51 (dd, 1H, J=6.6, 3-3Hz,10-H), 7.68 (dd, 1H, J=6.6 & 3.3Hz, 9-H).

<sup>13</sup>CMR (δ CDCl<sub>3</sub>, 75 MHz): 10.8 (C-6), 14.0 (C-2''), 23.6 (C-4), 22.9 (C-5), 28.8 (C-3), 30.2 (C-2'), 38.6 (C-2), 68.0 (C-1), 128.7(C-10), 130.8(C-9), 132.3(C-8), 167.6(C-7)

EI-MS (m/z, %): 390 [M+1]<sup>+</sup> (0.8), 279 (28.8), 167 (43.2), 149 (100), 132 (2.9), 133 (11.2), 83 (6.4), 71(18.9).

#### 5. Diethylphthalate (Gaikwad S.et.al., 2013)

Molecular formula: C<sub>12</sub>H<sub>14</sub>O<sub>4</sub>

IR (KBr cm<sup>-1</sup>): 1592, 1474, 1453, 1285, 1127, 1073, 745.

<sup>1</sup>H NMR (δ, 571 MHz): 1.39 (t, J=8Hz, 6H), 4.39 (q, J=6Hz, 4H), 7.75 (dd, J=10), 7.55 (dd, J=10Hz, 2H)

<sup>13</sup>C NMR: 56.39(C-1), 8.86(C-2), 123.60(C-5), 126.97(C-3), 162.42(C-6).

#### 6.3, 6, 8-trihydroxy-2-(3, 4dihydroxyphenyl)-4H-chromen-4-one (Ranjnish Kumar singh et al., 2013)

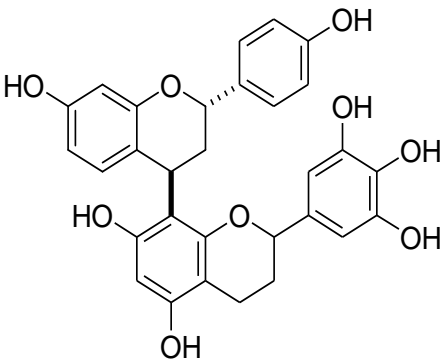
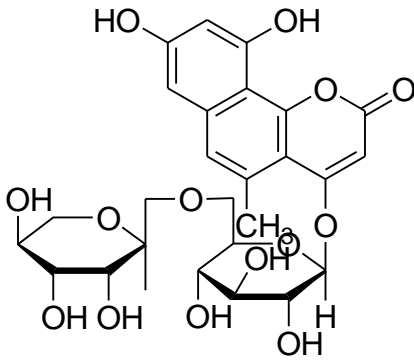
Molecular formula: C<sub>15</sub>H<sub>10</sub>O<sub>7</sub>

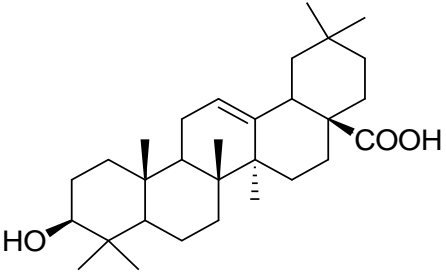
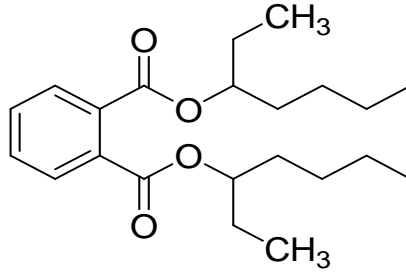
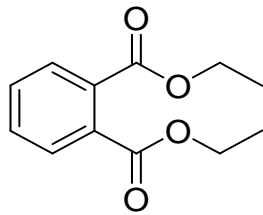
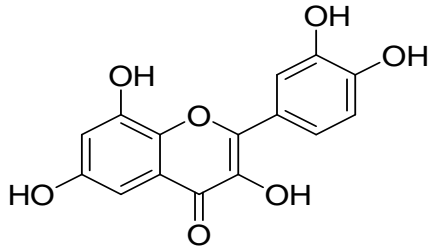
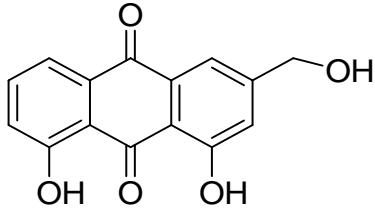
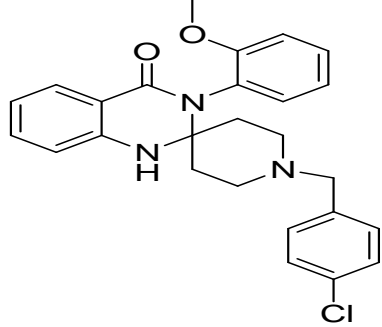
IR (KBr cm<sup>-1</sup>): 3490(O-H), 2900(C-H), 1670(C=O), 1570 -1480 (C=C).

<sup>1</sup>H NMR (500MHz, CD<sub>3</sub>OD): 6.28 [H-6,1H, d, J (H-6,H-8) 2.1 Hz], 6.54 [H-4,1H, d, J (H-8, H-6) 2.1Hz], 8.09 [H-2, H-6, 2H, dd, J (H-2,H-3) 9.0Hz, J(H-2H,H-6)2.1Hz], 7.01[H-3,H-5, 2H, dd, J(H-5,H-6) 9.0Hz, J(H-3, H-5) 2.1Hz].

EI-MS (m/z): 302,257,241,229,194,184,147,121,110,91,69.

**7. Emodin:** (Gaikwad S.*et al.*, 2014)Molecular Formula: C<sub>15</sub>H<sub>10</sub>O<sub>5</sub>IR (cm<sup>-1</sup>): 3391,1667,1626,1566, 1481.**<sup>13</sup>C NMR**(CDCl<sub>3</sub>): 166 (C-1), 108 (C-2), 165 (C-3), 109 (C-4), 122 (C-5), 23 (C-6), 123 (C-7), 162 (C-8), 192 (C-9), 182 (C-10), 135 (4-a), 132 (4-b), 108 (9-a) & 115(8-a).**EI-MS:** (M+1) + at 271.**8. 4-(4-chlorobenzyl)-2,3,4,5,6,7-hexahydro-7-(2-ethoxyphenyl)benzo(h)(1,4,7)triazecin-8(1H)-one** (M. Esakkiranjana *et al.*, 2014)Molecular Formula: C<sub>15</sub>H<sub>10</sub>O<sub>5</sub>IR (cm<sup>-1</sup>): 3391,1667,1626,1566 & 1481**<sup>1</sup>H NMR**( MeOH, 400 MHz): 1.8433 (t, J =11.49 Hz, 2H, CH<sub>2</sub>), 2.074 ( t, J = 5.7 Hz, 2H, CH<sub>2</sub>), 2.6871 (t, J = 6.2 Hz, 2H,CH<sub>2</sub>), 2.8562 (t, J = 7.9 Hz, 2H,CH<sub>2</sub>), 3.5138 (s, 2H, CH<sub>2</sub>), 3.8035 ( s, 3H, -OCH<sub>3</sub> ), 6.84 ( t, J = 10.3 Hz, 1H, CH), 7.0344-6.9767 (m, 2H, CH),7.0504 (d, J = 4.8 Hz, 1H, Ar CH), 7.607 ( d, J = 6.27 Hz, 1H, ArCH ), 7.1959 ( t, J = 5.76 Hz, 3 H, Ar CH), 7.607 ( d, J = 5.97 Hz, 2H, ArCH), 7.7803 ( s, 1H,NH ).**Table: Chemical structure of Phytoconstituents**

 <p style="text-align: center;">Avarol-I</p>	 <p style="text-align: center;">Avaraoside-I</p>

 <p>Oleanolic acid</p>	 <p>Di-9(2-ethyl)-hexylphthalate</p>
 <p>Diethylphthalate</p>	 <p>(3,6,8-trihydroxy-2-(3,4-dihydroxyphenyl)-4H-chromen-1-one)</p>
 <p>Emodin</p>	 <p>4-(4-chlorobenzyl)-2,3,4,5,6,7-hexahydro-7-(2-ethoxyphenyl)-benzo[h][1,4,7]triazecin-8(1H)-one</p>

## CONCLUSION

Present review discuss the phytopharmacology of various parts of the *Cassia auriculata* plant. The plant is studied exhaustively in last 30 years. It exhibit the high medicinal potential of *Cassia auriculata*. The review describe analytical data for identified chemical compound including different classes like flavonoids, sterols, terpenoid and carbohydrate. The spectroscopic data have been combining and represented. Nature having high phytochemical diversity, many of them possesses various biological activities and medicinal properties. This review is highly beneficial for modern ethno medical practioners to assess its potency scientifically with relevance to phytochemistry.

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