Research Article

In vivo and *In vitro* Anti-inflammatory Activity of Semi-Synthetic Derivatives of Isolated Solanesol from Tobacco Scrap

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ABSTRACT

Solanesol is a terpene isolated from tobacco waste and it is an important intermediate of nutrients such as vitamin K_2 and coenzyme Q_{10}. Researchers are examining the potential for producing vaccines and other high-value protein products from genetically engineered tobacco. In addition to these compounds, there are several additional products found in tobacco that might add to the overall revenue stream. Solanesol is one of them, which constitutes a portion of the Co-enzyme Q10 molecule; sucrose esters, natural insecticides and found on the leaf surface of certain Nicotiana species. The new method was prepared for the extraction of pure solanesol by a safe, economic, ecofriendly and industrial viable process. Similarly ten semi synthetic derivatives of solanesol were prepared with acceptable degree of purity, and their structures were elucidated with the help of IR, MASS, NMR (spectral data). *In vitro* and *in vivo* anti inflammatory activity showed that few semi-synthetic compounds showed improved anti inflammatory activity than solanesol. Comparison between *in vitro* and *in vivo* activity showed that PA1, MA1 and MA2 derivatives showed improved activity that the parent compound Solanesol.

Keywords: Solanesol, vitamin K_2 and coenzyme Q_{10}, anti-inflammatory

INTRODUCTION

Solanesol is commonly found in plant leaves and is one of the ingredients present in tobacco, potato leaf and mulberry leaves, Tobacco, especially has up to 0.85-3.75% of solanesol.

It is also found widely distributed in higher plants of Solanaceae family like *Solatium melongena, Solatium lycopersicum, and Capsicum annum.*

Solanesol is a terpene isolated from tobacco waste and it is an important intermediate of nutrients such as vitamin K_2 and coenzyme Q_{10}[3].

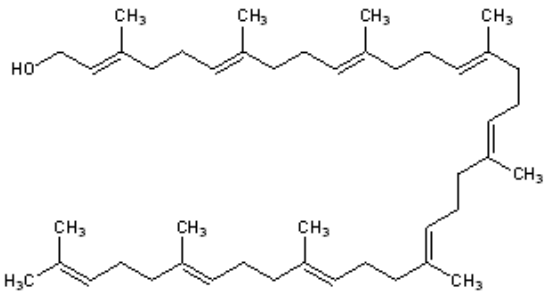
Tobacco Waste or dust is generated at various stages of post harvest processing of tobacco and also while manufacturing various tobacco products mainly during manufacture of tobacco products like cigarette and beedi.

The types of wastes generated during pre and post harvest practice of tobacco include suckers, stems, mid ribs, leaf waste and dust. Most cigarette factories are recycling the waste to produce reconstituted tobacco sheet and for blending and for the production of cheap tobacco products.

Researchers are examining the potential for producing vaccines and other high-value protein products from genetically engineered tobacco.

In addition to these compounds, there are several additional products found in tobacco that might add to the overall revenue stream. Solanesol is one of them, which constitutes a portion of the Co-enzyme Q10 molecule; sucrose esters, natural insecticides and found on the leaf surface of certain Nicotiana species.[9]

Figure 1: Solanesol (brown paste and white powder)

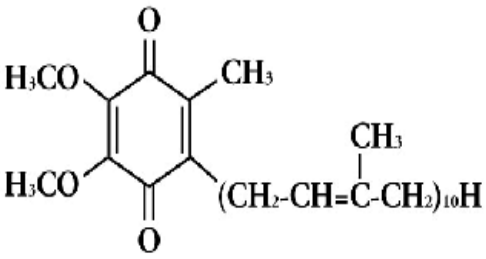


Solanesol

Solanesol, a 45-carbon, trisesquiterpenoid alcohol found in tobacco leaves and tobacco smoke.[15] Solanesol is a

major source of isoprene units required for the production of coenzyme Q_{10}. Coenzyme Q_{10} is used as a nutritional supplement in treatment of cardiovascular disease, heart diseases, cancers and ulcers also in the treatment of slow muscle degeneration[11]. Some semi-synthetic derivatives from different acid chlorides as novel hybrid derivatives from solanesol as wound healing agents were prepared successfully[16].

It is the starting material for many high-value bio-chemicals as vitamin-k analogues and coenzyme Q_{10}, which is virtually present in every cell in the human body and is known as the "miracle nutrient" as it can be also used as anti-aging agent. It is also a potentiating agent in these medicines. After introducing "Solanesol" radical into the structure of some medicines, the effect are increased distinctly[14].



Co enzyme Q_{10}

MATERIALS AND METHODS

Melting points were determined by capillary method and were uncorrected. The IR spectra is recorded by using Shimadzu Perkin Ekmer 8201 PC IR spectrometer using a thin film on potassium bromide pellets techniques and frequencies are expressed in cm^{-1}. The PMR spectra were recorded on Bruker Avance II 400 NMR spectrometer. All spectra were obtained in CDCl3 and DMSO. Chemical shift values are reported as values in ppm relative to TMS (d=0) as internal standard.

Experimental

Novel method for Extraction of Solanesol from Tobacco scrap

Powdered tobacco leaves were treated with hexane and the residue obtained was treated with hot methanol (50-55°C) to obtain crude Solanesol. To this 10% of methanolic KOH was added and heated at 55-60°C for 4 hours. The solid obtained was collected, toluene was added and then distilled under vacuum. Then the solution was filtered using silica bed to obtain 90% pure-crude Solanesol.

Preparation of Semi synthetic derivatives

To a solution of solanesol (1 mole) in dry DCM (30ml) were added different aromatic acids (1eq.), Dicyclohexyl carbodiimide (1 eq.) and DMAP (0.1 eq), stirred for six hours at RT. Separated Dicyclohexyl urea (DCU) was filtered off and the filtrate was evaporated to dryness in vacuum to give a white foamy mass.

The residue formed was re-extracted using DCM in a reflux condenser for about 30min. The physical data of synthesized compounds were tabulated in Table 1.

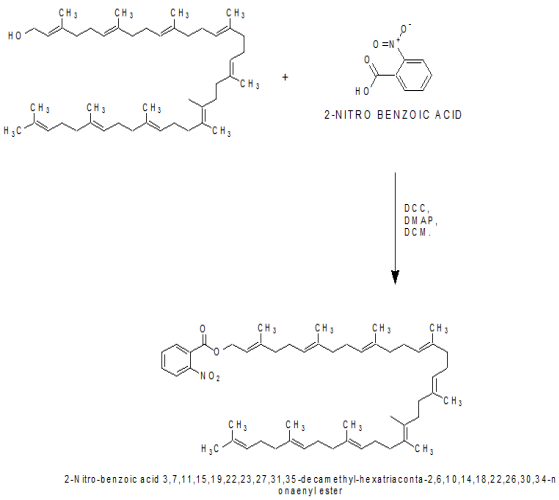
Table 1: Physical Data of the Synthesized Compounds

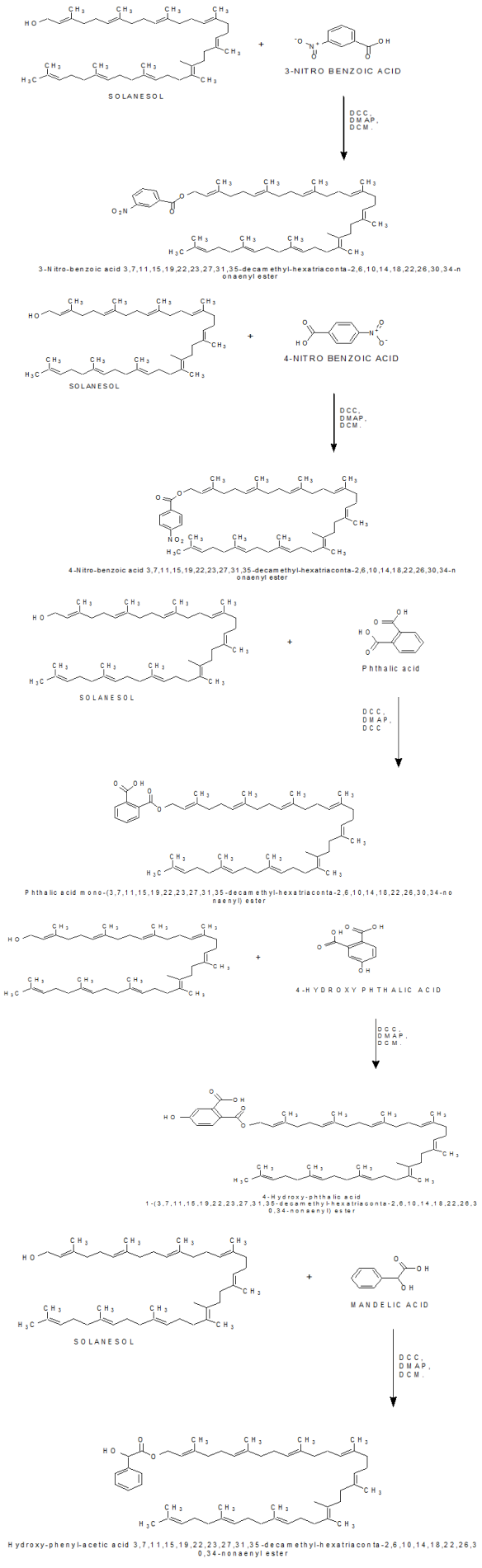
S. No	Compound	Physical state	Melting point	Yield
1	N_1	Semi-solid	56°C	85.6%
2	N_2	Semi-solid	42°C	80.3%
3	N_3	Semi-solid	50°C	80%
4	PA_1	Solid	52°C	78.3%
5	PA_2	Solid	49°C	79.6%
6	MA_1	Solid	50°C	73%
7	MA_2	Solid	47°C	69.5%
8	MA3	Solid	49°C	76.9%
9	CA	Solid	50°C	81.2%
10	PAA	Solid	49°C	78.7%

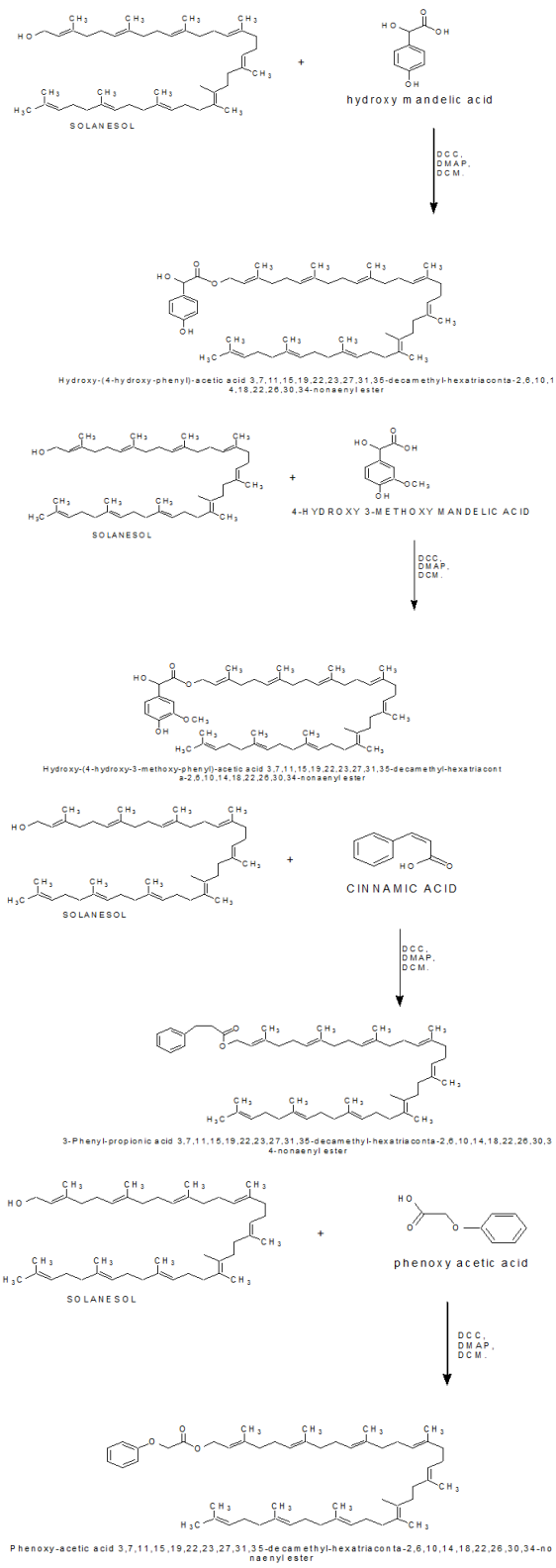
Table 2: Thin layer chromatography values of synthesized derivatives of Solanesol

S. No	Compound	Mobile phase used	R_f
1	N_1	n-hexane: ethyl acetate(9:1)	**0.86**
2	N_2	n-hexane: ethyl acetate(9:1)	**0.67**
3	N_3	n-hexane: ethyl acetate(9:1)	**0.72**
4	PA_1	n-hexane: ethyl acetate(9:1)	**0.83**
5	PA_2	n-hexane: ethyl acetate(9:1)	**0.62**
6	MA_1	n-hexane: ethyl acetate(9:1)	**0.59**
7	MA_2	n-hexane: ethyl acetate(9:1)	**0.55**
8	MA_3	n-hexane: ethyl acetate(9:1)	**0.69**
9	CA	n-hexane: ethyl acetate(9:1)	**0.78**
10	PAA	n-hexane: ethyl acetate(9:1)	**0.82**

The purity of the compound was further confirmed on silica gel TLC using n-hexane: ethyl acetate (9: 1) (Table-2).







Anti-inflammatory Activity

General Considerations

Inflammation was characterized two thousand years ago by Celsus by the four Latin words: Rubor, Calor, Tumor and Dolor. Inflammation has different phases: the first phase is caused by an increase of vascular permeability resulting in exudation of fluid from the blood into the interstitial space, the second one by infiltration of leukocytes from the blood into the tissues and the third

one by granuloma formation. Accordingly anti-inflammatory tests have to be divided into those measuring acute inflammation, subacute inflammation and chronic repair process. In some cases, the screening is directed to test compounds for local application. Predominantly, however, these studies are aimed to find new drugs against polyarthritis and other rheumatic diseases. Since the etiology of polyarthritis and other rheumatic diseases. Since the etiology of polyarthritis is considered to be largely immunologically, special tests have been developed to investigate various immunological and allergic factors[18].

In-vitro method

An array of physiological substances sometimes called autocoids, are involved in the process of inflammation and repair. These include histamine, serotonin, bradykinin, substance P and the group of eicosanoids (prostaglandins, thromboxanes and leucotrienes), the platelet activating factor (PAF) as well as cytokines and lymphokines. Their discovery makes the use of *in vitro* studies possible. The influence of non-steroidal anti-inflammatory agents on the eicosanoid pathway gave rise to numerous studies[17].

In-vivo method

The inflammation process involves a series of events that can be elicited by numerous stimuli, e.g., infectious agents, ischemia, antigen-antibody interactions, chemical, thermal or mechanical injury. The response is accompanied by the clinical signs of erythema, edema, hyperalgesis and pain[20]. Inflammatory responses occur in three distinct phases, each apparently mediated by different mechanism:

- An acute, transient phase, characterized by local vasodilation and increased capillary permeability.
- A substance phase, characterised by infiltration of leukocytes and phagocytic cells.
- A chronic proliferative phase, in which tissue degeneration and fibrosis occur.

According to these, pharmacological methods have been developed. Methods for testing acute and subacute inflammation are:

- UV-erythema in guinea pigs,
- Vascular permeability,
- Oxazolone – induced ear edema in mice,
- Croton-oil ear edema in rats and mice,
- Paw edema in rats (various modifications and various irritants),
- Pleurisy tests,
- Granuloma pouch technique (various modifications and various irritants).

The synthesized compounds were screened for anti-inflammatory activity. The experiment was conducted in the institutional animal house which was approved by CPCSEA. The animals were procured from the National Institute of Nutrition, Hyderabad, India and were maintained in animal cages at 25 ± 2°C, relative humidity of 45-55%, under a 12hr light and dark cycle; they were fed standard animal feed. All the animals were acclimatized for a week before use. The Institutional Animal Ethics Committee (IAEC) approved the protocol adopted for the experimental of animals.

Among the methods for screening of anti-inflammatory agents carrageenan induced rat paw edema method is simple and most commonly used.

Procedure

Young adult male wistar rats weighing 150-200gm were used which are acclimatized to the laboratory rat feed and clean water. Rats were fasted for 12 hrs prior to experiment, while access to water throughout the experiment, while allowing access to water throughout the experiment. Rats were divided into 12 groups while each group containing 3 animals. One group of animals received 1% CMC Saline solution which served as control. Second group of animals 50mg/kg diclofenac sodium solution which serves as standard. The remaining 10 groups of animals received 50mg/kg and 100mg/kg of the synthesized compounds. A mark was made on both the hind paws just beyond the tibiotarsal junction, so that every time the paw is dipped in the mercury column up to the marked level to ensure constant paw volume. After 1hr of administration of the test and standard samples, 0.1ml of 1% carrageen and suspension (in normal saline) was injected into dorsal region of the sub plantar surface of hind paw of rat subcutaneously with the help of 26G needle, the initial paw volume of each rat was recorded before drug administration. The paw volumes were measured at the end of 1, 2, 3, 4 hours using plethysmometer. Any change in paw volume of rats was obtained by subtracting initial paw volume from the paw volume at different time intervals. The average value of edema was calculated by taking the average of each group at different hours. Percentage inhibition of edema was calculated for each group with respect to its control group[23].

$$Percentage\ Inhibition\ = \left(\frac{A_0 - A_T}{A_0}\right) \times 100$$

Where A_0 is the mean increase paw volume in rats treated with control and A_T is the mean increase in paw volume in rats treated with test. (Table 4)

In-Vitro anti inflammatory activity of Solanesol

Solanesol can be used as an anti-inflammatory agent. Therefore, our investigation was aimed to screen anti-inflammatory activity of Solanesol by membrane stabilizing method. The prevention of hypo tonicity induced human red blood cells (HRBC) membrane lysis

was taken as a measure of anti inflammatory activity. The potency of Solanesol was compared with standard Diclofenac sodium. Solanesol showed significant membrane stabilizing activity of 82.14% at a concentration of 100µg/ml.

Preparation of Red Blood Cells (RBCs) Suspension

Fresh whole human blood (10ml) was collected and transferred to the heparinized centrifuged tubes. The tubes were centrifuged at 3000 rpm for about 10min and were washed three times with equal volume of normal saline. The volume of the blood was measured and reconstituted as 10% v/v suspension with normal saline.

Membrane Stabilizing activity (Heat induced Haemolysis)

The reaction mixture contained aqueous solution of Solanesol (20-200µg/ml) and 1 ml of 10% RBCs suspension in normal saline. Standard contained Diclofenac sodium (100µg/ml) in normal saline. Instead of drug only saline was added along with 1 ml of 10% RBCs suspension to the control test tube. In the same way, the reaction mixtures of Solanesol derivatives were prepared. Tubes containing reaction mixture were incubated in a water bath at 56°C for 30min. At the end of incubation; the tubes were cooled under running tap water.

The reaction mixture was centrifuged at 2500 rpm for 5 min and the absorbance of the supernatants was measured at 560nm.

Membrane stabilizing activity (in %) was calculated by the following formula:

$$Inhibition\ (\%) = \left(\frac{Optical\ densit\ of\ control - Optical\ density\ of\ test}{Optical\ density\ of\ control}\right) \times 100$$

(Table 5)

RESULTS AND DISCUSSION

All semisynthetic derivatives does not show any characteristic absorption at 3940 cm^{-1} which is characteristic absorption of OH group for Solanesol, instead all derivatives shown absorption between the range of 1734-1753cm^{-1} which is characteristic of ester moiety. HNMR results showed that all synthetic derivatives have triplet signal at 8.223-8.3 ppm assignable to ester moiety. For N1, N2, N3, CA, PAA multiplet was found between 7.00-8.3ppm assignable aromatic protons. Because all the derivatives are unsaturated compounds a multiplet was found at the range of 1.71ppm assignable to 33 protons. For PA1 and PA2 singlet was found at 11.00ppm because of the presence of COOH group. LC-MS [API/ESI-MS (80 eV)] (m/z %): 773 (M+H), 772 (M+ H), 773 (M+ Li), 772 (M+ H), 789 (M+ Li), 756 (M+ H), 773 (M+H), 804(M+Na), 754(M+H), 756 (M+ H) (Table 3). PA1, MA1 and MA2 showed improved *In vivo* and *In vitro* anti inflammatory activity than parent solanesol. (Table 4 & 5)

Statistical Analysis

Values from *in-vivo* anti-inflammatory shown in tables and figures were expressed in Mean ± SD. Analysis was performed using one way analysis of variance (ANOVA) (by "GraphPad Prism 5" software) was applied for determining the statistical significance between different groups. The results were significant in the level of *p < 0.05.

Table 3: Spectral Data

S. No	COMPOUND	IR(KBR)	MASS (m/z)	NMR(CDCl3,200(MHz)
1	NI	1734.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2950 cm^{-1} (C-H str).	773	8.21 ppm (t, 4H, $COOC_6H_5$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.92 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 7.00 – 8.30 ppm (m, 4H, 1 x C_6H_4).
2	NII	1753.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O) 2930 cm^{-1} (C-H str	773	8.223-8.238 ppm (t, 4H, $COOC_6H_5$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.92 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 7.00 – 8.90 ppm (m, 4H, 1 x C_6H_4).
3	NIII	1735.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2850 cm^{-1} (C-H str).	772	8.223 ppm (t, 4H, $COOC_6H_5$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.92 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 8.23 – 8.30 ppm (m, 4H, 1 x C_6H_4).
4	PAI	1743.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2850 cm^{-1} (C-H str).	772	8.223-8.238 ppm (t, 4H, $COOC_6H_4$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.92 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 7.71 – 8.24 ppm (m, 4H, 1 x C_6H_4), 11.0 ppm (s, 1H, 1 x COOH).
5	PAII	1723.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2740 cm^{-1} (C-H str).	789	8.223-8.238 ppm (t, 4H, $COOC_6H_3$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.92 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 7.00 – 8.10 ppm (m, 4H, 1 x C_6H_4), 5.0 ppm (s, 1H, 1 x CHOH), 11.0 ppm (s, 1H, 1 x COOH).
6	MAI	1733.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2654cm^{-1} (C-H str).	756	8.423-8.638 ppm (t, 4H, $COOC_6H_5$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.75 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 5.34 ppm (m, 1H, 1 x CH), 7.10 – 7.30 ppm (m, 4H, 1 x C_6H_4), 2.0 ppm (s, 1H, 1 x CHOH).
7	MAII	1763.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2554cm^{-1} (C-H str).	773	8.123-8.238 ppm (t, 4H, $COOC_6H_4$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.75 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 6.60 – 7.10 ppm (m, 4H, 1 x C_6H_4), 5.0 ppm (s, 1H, 1 x CHOH), 2.0 ppm (s, 1H, 1 x CHOH).
8	MAIII	1753.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2434cm^{-1} (C-H str).	804	8.223-8.338 ppm (t, 4H, $COOC_6H_3$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.75 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 5.34 ppm (m, 1H, 1 x CH), 6.53 ppm(m, 4H, 1 x C_6H_4), 5.0 ppm (s, 1H, 1 x CHOH), 2.0 ppm (s, 1H, x CHOH).
9	CA	1733.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2657cm^{-1} (C-H str).	754	8.323-8.438 ppm (t, 4H, $COOC_6H_5$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 2.94 ppm (m, 2H, 2 x CH_2), 2.58 ppm (m, 2H, 2 x CH_2), 4.75 ppm (t, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 7.10 – 7.20 ppm (m, 4H, 1 x C_6H_4).
10	PAA	1643.12 cm^{-1} (C=O), 1216.17 cm^{-1} (C-O). 2654cm^{-1} (C-H str).	756	8.223-8.238 ppm (t, 4H, $COOC_6H_5$ of ester), 1.71 ppm (m, 33H, 3 x CH_3), 2.00 ppm (m, 32H, 2 x CH_2), 4.90 ppm (m, 2H, 2 x CH_2), 4.75 ppm (m, 2H, 2 x CH_2), 5.20 ppm (m, 8H, 1 x CH), 6.70 – 7.20 ppm (m, 4H, 1 x C_6H_4).

Table 4: Mean edema volume and percentage inhibition of albino rats

Treatment	Dose (Mg/kg)	Mean edema volume (ml) / Percentage inhibition			
		1hr	2hr	3hr	4hr
NI	50mg/kg 100mg/kg	0.45±0.010 (4.2) 0.356±0058 (24.2)	0.356±0.0057 (50.7) 0.287±0.0064(59.)	0.273±0.0057 (61) 0.216±0.0057 (75)	0.213±0.0057 (68) 0.20±0.10 (77.5)
NII	50mg/kg 100mg/kg	0.513±0.0057 (8.5) 0.416±0.0052 (11.4)	0.47±0.0057 (33) 0.38±0.0040 (46.4)	0.376±0.00575((7.9) 0.284±0.005 (68.1)	0.273±0.010 (69.6) 0.228±0.0075 (74.3)
NIII	50mg/kg 100mg/kg	0.52±0.0057 (10.6) 0.379±0.0070 (19.3)	0.463±0.0057 (35.2) 0.278±0.0072 (61.9)	0.36±0.0057 (59) 0.254±0.0051 (71.1)	0.2533±0.0057(71.9) 0.227±0.0025 (74.4)
PAI	50mg/kg 100mg/kg	0.413±0.0057 (12.7) 0.354±0.0052 (24.6)	0.373±0.0057 (47.8) 0.284±0.0052(60)	0.36±0.01 (59.09) 0.227±0.0064 (75)	0.96±0.0057 (66.7) 0.18±0.010 (79.7)
PAII	50mg/kg 100mg/kg	0.53±0.011 (12.7) 0.426±0.0052 (10.6)	0.426±0.0057 (40.8) 0.38±0.0040 (46.4)	0.386±0.0057 (56.13) 0.286±0.0057 (67.5)	0.273±0.0057 (62) 0.187±0.0064 (78.9)
MAI	50mg/kg 100mg/kg	0.610±0.010 (29.7) 0.354±0.0052 (24.6)	0.573±0.0057 (19.7) 0.25±0.010 (64.7)	0.473±0.0057 (46.5) 0.223±0.0057 (76.1)	0.373±0.0057 (58.4) 0.186±0.0057 (79.1)
MAII	50mg/kg 100mg/kg	0.543±0.0057 (14.8) 0.356±0.0057(24.2)	0.473±0.0057 (33.8) 0.286±0.0057(59.7)	0.423±0.0057(50.79) 0.253±0.0057(71.25)	0.373±0.0057 (58.08) 0.176±0.0057 (80.2)
MAIII	50mg/kg 100mg/kg	0.573±0.0057 (32.7) 0.316±0.0057(21.2)	0.543±0.0057 (61.1) 0.276±0.0057(23.9)	0.456±0.0057 (77.2) 0.20±0.010 (48.18)	0.386±0.0057 (80.3) 0.175±0.0057 (57.3)
CA	50mg/kg 100mg/kg	0.376±0.0057 ((20) 0.613±0.0057 (30.4)	0.573±0.0057 (19.7) 0.26±0.0057 (63.3)	0.486±0.0057 (45.5) 0.234±0.0051 (73.4)	0.396±0.0057 (55.5) 0.20±0.100 (77.5)
PAA	50mg/kg 100mg/kg	0.586±0.0057 (30.4) 0.298±0.0072(36.5)	0.463±0.0057 (19.7) 0.328±0.0072(54.9)	0.396±0.0057 (45.5) 0.274±0.0052 (68.8)	0.326±0.0057 (55.5) 0.189±0.0030 (78.7)
Diclophenac sodium	100mg/kg	0.236±.0.0057 (49.7)	0.20±.0.010 (71.8)	0.176±.0.0057 (80)	0.163±.0.0057 (81.6)
Control	-	0.47	0.71	0.88	0.89

Each value is Mean ± S.E.M (n=10), *Denotes significance difference when compared to control values at *p<0.05.

P value is < 0.05 and the values are significant

Table 5: *In Vitro* Anti Inflammatory Activity

Compound	Conc (µg/ml)	Absorbance (mean ± SEM)	% Inhibition
N1	50	0.33±0.0066	34
	100	0.246±0.0033	52
	200	0.22±0.0057	56
N2	50	0.366±0.0033	28
	100	0.263±0.0033	48
	200	0.226±0.0033	56
N3	50	0.190±0.0057	62
	100	0.136±0.0066	72.8
	200	0.116±0.0033	78
PA1	50	0.196±0.0033	60.8
	100	0.146±0.0033	70.8
	200	0.103±0.0033	79.4
PA2	50	0.376±0.0033	24.8
	100	0.286±0.0033	44
	200	0.233±0.0033	53.4
MA1	50	0.190±0.0057	62
	100	0.170±0.0057	66
	200	0.146±0.0033	72
MA2	50	0.186±0.0033	64
	100	0.153±0.0033	70
	200	0.1433±0.0033	71.4

MA3	50	0.3533±0.0033	30
	100	0.243±0.0033	51.4
	200	0.18±0.0033	64
CA	50	0.396±0.0033	22
	100	0.366±0.0033	28
	200	0.273±0.0033	46
PAA	50	0.3533±0.0033	30
	100	0.243±0.0033	51.4
	200	0.18±0.0033	64
CONTROL		0.5±0.0057	
STD	50	0.176±0.0033	66
SOL	50	0.23±0.0057	54
	100	0.190±0.0057	62
	200	0.166±0.0033	66.8

Each value is Mean ± S.E.M (n=10), *Denotes significance difference when compared to control values at *p<0.05

CONCLUSION

Solanesol is required for the production of CoEnzyme Q_{10}, used as nutrition supplement, cardiac diseases etc. Solanesol is extremely interesting compound and exerts various biological activities. The purity of Solanesol was increased about 90% than earlier method and it is considered as one of "the greatest drug with potential growth in coming centuries". Its semi synthetic derivatives are confirmed by IR and NMR. Antioxidant activity and antimicrobial activity of the semi synthetic compounds like SC-I, SB-II, SI-III, SN-IV, SNT-V, ST-VI and SCA-VII showed greater improvement than parent. These semi synthetic derivatives are confirmed by IR (Spectro 2060+, Analytical technologies limited) and NMR (Varian Gemini-200, Varian unity-400 and Avance 300MHz Bruker Ux-NMR instrument).

The present process achieves extracting Solanesol from relatively inexpensive materials. It becomes key natural intermediate for synthesizing various biologically important semi synthetic derivatives. This is more economical and having commercial value because these potentially useful semi synthetic derivatives are obtained from tobacco waste.

CoQ_{10} is considered as one of "the greatest drugs with potential growth in 21st century". It is thus clear that whether used for synthesizing CoQ_{10} or used as a drug itself, highly purified Solanesol will usher in its "Golden Period" of market profession in pace with continuous deepening of research and practical application.

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