STUDIES IN THE SYNTHESIS OF FURANO COMPOUNDS

INTRODUCTION.

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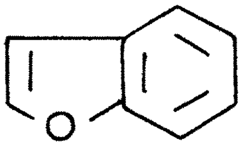
The chemistry of oxygen heterocyclic compound is one of the most important branches of organic chemistry. It is equally interesting for its theoretical implications, for the diversity of its synthetic procedures and for the physiological and industrial significance of the heterocyclic compounds. They also occur in nature. The furan ring is commonly found in plant products, either fused with benzene nucleus to form benzofurans (1) or with coumarins or chromones to form an interesting group of compounds known as furobenzopyrones. These may be grouped into (A) furocoumarins or furo-benzo-α-pyrones (2) and (B) furo-benzo-γ-pyrones, which are further classified into (i) furochromones (3), (ii) furoflavones (4), (iii) furoisoflavones (5), (iv) furoxanthones (6), etc. Fusion of benzene ring with furo-benzo-α-pyrone nucleus constitutes a group of compounds called coumestan or 6H-benzo-furo (3,2-c) [1] -benzopyran-6-one[1] (7).

Furo benzopyrones and coumestans occupy a prominent position among the plant products and comprise a body of organic substances of extraordinary variety and interest. These compounds have close structural and chemical interrelationship that appears to reflect a close biogenetic relationship in the process by which they are formed in plants.

Furocoumarins are found especially in the Umbelliferae, Rutaceae and Leguminoseae families. Karrer's[2] review on 'Furocoumarins' lists the number of furocoumarins which had been isolated from natural sources while Mustafa's[3] book on ‘Furopyrans and Furopyrones’ gives the complete review of natural as well as synthetic furo-benzo-α-pyrones and furo-benzo-γ-pyrones.



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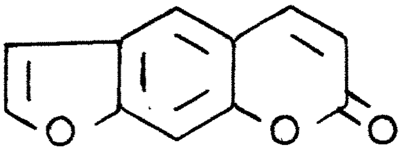

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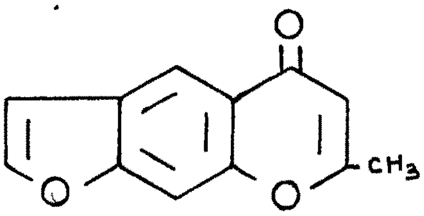

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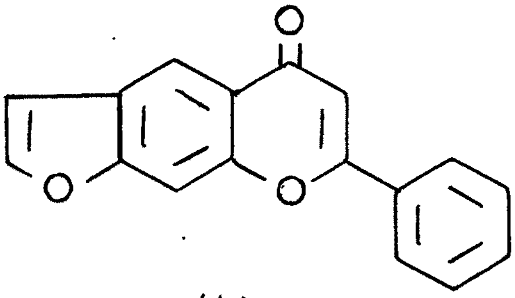

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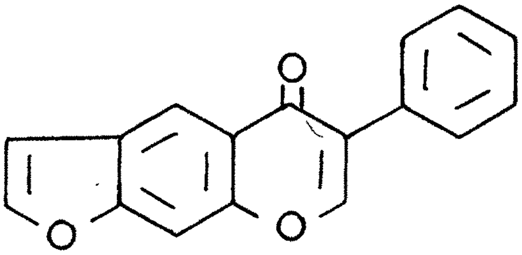

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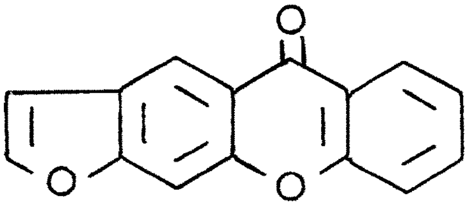

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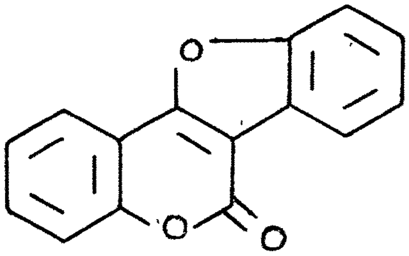

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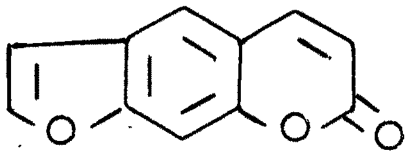
An interesting property of furocoumarins is their ability to fluoresce under ultra-violet light. This is not merely a unique feature of this group, but is, nevertheless, a useful diagnostic property[4,5]. A greenish fluorescence is generally noted with many of the furocoumarins in a neutral state. There exists a structure-activity relationship between the absorption of ultra-violet light and the photo sensitizing action of furocoumarins, which is described later. Furocoumarins showed a more intense band at the lower wave length as compared to coumarins. Infra-red analysis has been used in the structural characterization of furocoumarins. High resolution nuclear magnetic resonance spectra have been also of use in the structural determination of furocoumarins, Use of mass-spectrometry in structural studies of furocoumarins has not been exploited to any degree. However, the techniques has been used to determine the exact molecular weight of compounds which are scarce[6]. Colourimetric determination furocoumarins has been mainly based on their reaction with diazotized sulfanilic acid in alkaline medium[7] and the deep violet colour developed with 8-amino-5-hydroxy-2-methyl-furo-

4',5',6,7 chromone in the presence of alkali[8]. Peucedanin has been determined recently by titrating its alcoholic solution in sodium hydroxide with sulphuric acid using phenol red[9].

Natural furocoumarins are not merely metabolic products of the living cell, but they possess varied and often remarkable physiological activities also. The role of certain plant juices and extractions as dermal photosensitizing agents has been known for many years. Juices of various parts of these plants, e.g. Parsley, Celery, Figs and Parsnip[10] after contact with the skin and exposure to sunlight cause changes on mammalian skin manifested by erytherma and increased pigmentation. Thus furocoumarins, psoralene (8) and xanthotoxin (9) possess photosensitizing activity.



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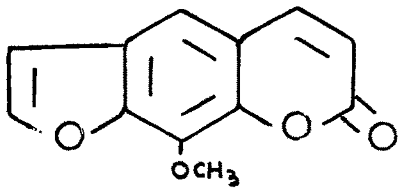

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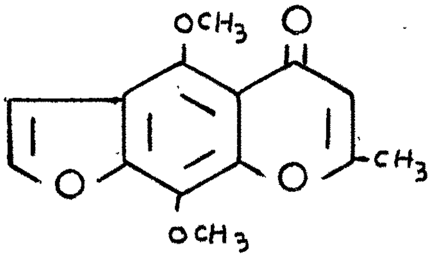
The structure of natural furochromones are similar to those of the linear furocoumarins. These are found in plants Ammi visnaga L, and ammi majus L, belonging to the family Umbelliferae. Here again the selection of the proper plant part is of great importance. Isolation[11-22] and purification[23-29] of furochromone is similar as in furocoumarins. Khellin (10) and Visnagin (11) are the important member of this group.



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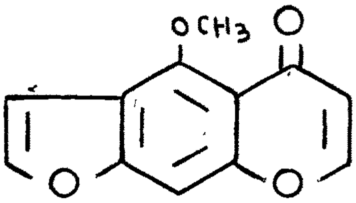

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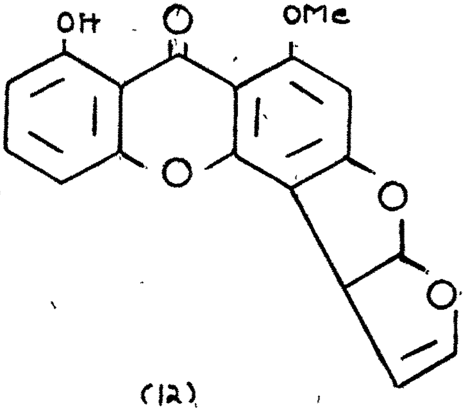
While xanthones have been found in plants and in fungi, the knowledge of naturally occuring furoxanthones has been gained by the isolation of sterigmatocystin (12) which has a unique structure.



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A condensed furan nucleus occur in a number of related natural products, viz., furocoumarins, -chromones,-flavones, etc. and in an attempt to prepare physiological active molecules of simple structure, analogus to biological active Khellin[30], the synthesis of furoxanthones has been recently achieved.

The present work deals with the synthesis of furo compounds.

Chapter I deals with the synthesis of furo-benzo-α-pyrones derivatives. Different substituted psoralene derivatives were synthesised using o-hydroxy allyl coumarins as starting compounds. It also deals with the synthesis of 7H-furo [3,2-f] [1] benzopyran-7-one, 2-methyl-7H-furo [3,2-f] [1] benzopyran-7-one and Difurocoumarin derivatives which were synthesised from diallyloxy coumarin derivatives. The structures of the compounds are supported by ultra-violet, infra-red and nuclear magnetic resonance spectra.

Chapter II deals with the synthesis of linear as well as angular furo-benzo-γ-pyrones, i.e. furochromones and furoxanthonse. These were synthesised from o-hydroxy acyl and o-hydroxy allyl benzo-γ-pyrone derivatives. The structures of the compounds are supported by recording ultra-violet, infra-red and nuclear magnetic resonance spectra.

Chapter III deals with the synthesis of furo-coumestan derivatives. 4-Hydroxycoumarin derivatives on dehydrogenative coupling with catachol gave coumestan derivatives upon which furan ring was built up by Claisen migration and cyclisation followed by dehydrogenation with palladised charcoal. The structures of the intermediates and final compounds are confirmed by ultra-violet, infra-red and nuclear magnetic resonance spectra.

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