SOME REACTIONS OF dl-CAMPHORIC ACID DERIVATIVES

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Amide-ester from the racemic allo- and ortho-Camphoric acid esters have now been prepared and shown to be identical with the esters prepared from α and β-camphoramic acids respectively. NMR data have been given for some reaction products of camphoric acid esters and some new products have been described.

In an earlier communication\(^1\) some reactions of dl. ortho- and allo-camphoric acid esters were discussed, and they were shown to be cis- and trans-methyl hydrogen camphorate respectively. The NMR spectra of the ortho-ester taken in CDCl\(_3\) solution (with TMS internal standard) gave main peak positions of the (C)-CH\(_3\) methyls at 9.12 (3H) and 8.71 (6H)\(^\gamma\) in addition to ester methyl peak at 6.30\(^\gamma\) (3H). Under identical conditions allo-ester showed its (C)-CH\(_3\) peaks at 9.14(3H), 8.78(3H) and 8.70 (3H)\(^\gamma\) in addition to ester methyl at 6.30\(^\gamma\) (3H). The additional peak at 8.78\(^\gamma\) in case of allo-ester cannot be readily explained on the basis of the two esters being position isomerides, whereas, stereoisomerism as suggested earlier can explain the additional peak on the basis of environmental influence of the two carbonyl functions on the gem-dimethyl group on the cyclopentane ring of the camphoric acid esters. However, on esterification with diazomethane both ortho- and allo-esters give identical peak positions in their NMR spectra at 9.27 (3H), 8.81 and 8.80 (6H)\(^\gamma\) in addition to one peak at 6.36 (6H)\(^\gamma\). On lithium aluminium hydride reductions ortho- and allo-esters gave dialcohols, m.p. 136°C and 134°C respectively. They did not depress each others melting point, but in the IR spectrum taken in KBr pellet a small difference in peak positions at 1021 cm\(^{-1}\) (ortho) and 1028 cm\(^{-1}\) (allo) was noted.

It was felt that the amides of the acid esters prepared under mild conditions may give conclusive evidence of stereoisomerism.

The ortho-esteramide, m.p. 134-36\(^°\) and allo-esteramide, m.p. 120\(^°\), were prepared from the acid-esters through their acid chlorides under mild conditions.
Experiments directed towards the syntheses of suitable precursors for 9,10-dehydro-anthracene are described. Pyrolysis of a mercury derivative of anthracene and the reaction of lithium with 9,10-dibromoanthracene are discussed.

The pioneering studies of Wittig,\(^1\) Roberts\(^3,4\) and Huisgen\(^5\) culminated in the recognition that certain benzene derivatives under suitable conditions undergo a 1,2-elimination to give benzyn as the reactive intermediate. These developments posed the question as to whether dehydroaromatic structures whose unsaturation involved other than adjacent positions were capable of existence. Subsequent investigations\(^5-7\) were therefore directed towards obtaining experimental evidence for a 1,4-elimination, which in the case of benzene would lead to \(p\)-phenylene (A) and/or its mesomeric form 1,4-cyclohexadiene-dicarbene (B).

9,10-Dehydroanthracene (I) was first discussed by Richardson, Browner and Amstutz\(^8\) in 1956. These workers studied the kinetics of halide elimination from aryl halides with piperidine at \(ca.\) 200\(^\circ\). The energy of activation for these reactions was found to be around 25 kcal/mole. In the case of \(g\)-chloro- and \(g\)-bromoanthracene, however, a reduction in the energy of activation by about 5–9 kcal/mole was observed. It seems likely that the lower energies of activation are to be attributed to the resonance stabilisation of the transition state for the additive nucleophilic substitution rather than to a \(p\)-elimination mechanism leading to (I).

In an attempt to detect I, Hauser\(^9\) investigated the reaction of \(g\)-chloro-10-bromoanthracene (II) with phenyllithium. Mikhaliov and V. Bronovitskaya\(^10\) had already shown the product of this reaction to be \(g\)-chloro-10-lithioanthracene (III), stable in refluxing diethyl ether. Heating II with excess phenyllithium in tetrahydrofuran for 20 hr followed by carboxylation did not give the expected acid. \(g\)-Phenylanthracene (IV) and anthracene were the only products isolated.

The author's work was directed at trapping I with olefins. It did not seem improbable that I might have the anthracene-9,10-dicarbene (Ia) structure, since Ia, unlike anthracene, profits from the complete aromatisation of the outer benzene rings. Further, Ia should add to olefins in the manner of carbenes\(^11\) to give the stable cyclopropane derivatives.

*So named, following G. Wittig, Naturwissenschaften, 30, 696 (1942), who coined the name dehydrobenzol for what in the Anglo-Saxon literature was later termed benzyn.\(^2\)

The choice of nomenclature in our case seems well founded since the alternative anthracyne would imply the structurally impossible triple bond between the meso positions of anthracene.

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CHARACTERIZATION OF TAR FROM GASIFICATION OF MAKERWAL COAL

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Tar from the gasification of Makerwal coal was characterized by solvent extraction and elution adsorption chromatography. The whole tar is separated into broad chemically identical fractions. The results of some preliminary evaluation experiments are also discussed, in the light of which it may be possible to find some suitable use for this tar.

Introduction

The tar under investigation is obtained by the gasification of Makerwal coal from Trans-Indus area by the Lurgi process at Daudkhel Fertiliser Factory for the production of hydrogen, for the subsequent manufacture of ammonium sulphate. By this method 2.2 tons per day of a lower boiling fraction (60°-200°C) designated as 'Raw gasoline' and 5 tons per day of a higher boiling tar fraction, are obtained as by-products. A process has been developed to utilise the 'raw gasoline' for the production of an insecticide. However, no suitable use appears to have been found to utilise the higher boiling tar fraction. The object of this work is therefore, to characterize this tar with a view to finding some suitable use for this by-product or similar products as and when they are available.

A method for characterization of tar based on solvent extraction and chromatography was used. It has several advantages over the conventional method of tar analysis based on distillation technique.

Experimental

As a necessary preliminary the tar was distilled by the standard method to ensure that it did not contain any lower boiling compounds, (below 150°C) which would otherwise escape during the recovery of solvents from the fractions of tar in the above-noted method of analysis. The results of tar distillation are given in Table 1. The moisture content of tar was determined by the Dean and Stark method. The analysis of tar in duplicate was carried out by two different solvent extraction methods and subsequent elution adsorption chromatograph on silica gel as follows:—

(a) The method of tar analysis described by Blunt and Vahrman was followed, excepting that the benzene-insoluble portion was not analysed further. 20 g of undehydrated tar were used for each analysis (Table 2).

(b) As an alternate method of analysis, 20 g of undehydrated tar were extracted with successive portions of benzene till the extract was almost colourless. The extracts were mixed and centrifuged at 3000 rev/min to remove suspended insoluble material if any. From the extract, phenols and bases were separated as in (a). The neutral portion after recovering benzene was extracted with light petroleum (40°-60°C) and

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Tar distillate</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.p. of tar</td>
<td>166</td>
</tr>
<tr>
<td>160</td>
<td>1.8 (water)</td>
</tr>
<tr>
<td>170</td>
<td>2.2</td>
</tr>
<tr>
<td>180</td>
<td>2.3</td>
</tr>
<tr>
<td>190</td>
<td>2.5</td>
</tr>
<tr>
<td>200</td>
<td>3.5</td>
</tr>
<tr>
<td>210</td>
<td>5.3</td>
</tr>
<tr>
<td>220</td>
<td>8.2</td>
</tr>
<tr>
<td>230</td>
<td>12.7</td>
</tr>
<tr>
<td>240</td>
<td>16.5</td>
</tr>
<tr>
<td>250</td>
<td>18.0</td>
</tr>
<tr>
<td>260</td>
<td>22.4</td>
</tr>
<tr>
<td>270</td>
<td>28.7</td>
</tr>
<tr>
<td>280</td>
<td>47.4</td>
</tr>
<tr>
<td>290</td>
<td>51.7</td>
</tr>
<tr>
<td>300</td>
<td>58.8</td>
</tr>
<tr>
<td>310</td>
<td>63.0</td>
</tr>
<tr>
<td>320</td>
<td>64.0</td>
</tr>
<tr>
<td>330</td>
<td>65.6</td>
</tr>
<tr>
<td>340</td>
<td>66.6</td>
</tr>
<tr>
<td>350</td>
<td>72.1</td>
</tr>
<tr>
<td>360</td>
<td>73.1</td>
</tr>
<tr>
<td>Pitch 7360</td>
<td>24.3</td>
</tr>
</tbody>
</table>
INTRODUCTION

Galena occurs in both crystalline and non-crystalline rock. It is commonly associated with other sulphide minerals such as pyrite, sphalerite and chalcopyrite. The non-metallic minerals, e.g., quartz, calcite, barytes, fluor spar, etc., constitute the gangue. The chief modes of occurrence are in veins, in flat or off-shoots from veins, usually following the bedding planes replacing limestone.

Certain deposits of galena are not rich with respect to lead contents. Extraction of lead from galena has been reported in another communication. This paper deals with beneficiation of low grade lead ore by froth floatation process.

EXPERIMENTAL

Crushing of Ore.—The ore was crushed in a set of crushing rolls. It was then ball-milled to different mesh sizes.

RESULTS AND DISCUSSION

TABLE I.—EFFECT OF CONDITIONING REAGENTS ON PURITY AND RECOVERY OF PbS.

<table>
<thead>
<tr>
<th>Reagents</th>
<th>% of PbS</th>
<th>Recovery %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na2SiO3</td>
<td>48</td>
<td>55</td>
</tr>
<tr>
<td>Na2CO3</td>
<td>65</td>
<td>75</td>
</tr>
<tr>
<td>NaOH</td>
<td>62</td>
<td>67</td>
</tr>
<tr>
<td>H2SO4 pH 4.5</td>
<td>42</td>
<td>50</td>
</tr>
<tr>
<td>K2Cr2O7</td>
<td>50</td>
<td>52</td>
</tr>
</tbody>
</table>

The reagents were tried under the following conditions:

| Weight of the batch | 1000 g |
| Particle size       | -100+120 mesh (B.S.S.) |
| Conditioning time   | 10 min |
| Time for froth collection | 20 min |
| Collector           | Potassium ethyl xanthate 0.2 lb/ton |
| Frother             | Cresol 0.2 lb/ton |

From Table 1 it is evident that Na2CO3 is the best conditioning agent.

pH of Pulp: Table 2 indicates the effect of pH on the floatation behaviour of lead sulphide.

TABLE 2.—EFFECT OF pH ON THE PERCENTAGE PURITY OF LEAD SULPHIDE.

<table>
<thead>
<tr>
<th>pH</th>
<th>% Purity of lead sulphide</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.0</td>
<td>45</td>
</tr>
<tr>
<td>7.5</td>
<td>58</td>
</tr>
<tr>
<td>8.0</td>
<td>70</td>
</tr>
<tr>
<td>8.5</td>
<td>78.5</td>
</tr>
<tr>
<td>9.0</td>
<td>79</td>
</tr>
<tr>
<td>9.5</td>
<td>78</td>
</tr>
<tr>
<td>10.0</td>
<td>72</td>
</tr>
<tr>
<td>10.5</td>
<td>70</td>
</tr>
</tbody>
</table>
MINERALOGY OF SOME ASBESTOS FROM NORTH-WEST PAKISTAN

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Chemical, X-ray, differential thermal analysis and thermogravimetric data are presented for asbestos from Charsadda Tehsil, Khyber and Mohmand Agencies. Asbestos from Charsadda area was identified to be chrysotile. Khyber and Mohmand minerals were tentatively grouped with tremolite-anthophyllite asbestos. Poor strength of fibres limits their commercial utilisation.

The critical shortage of asbestos fibre in Pakistan today brings to the foreground the question of locating and developing new deposits. Sporadic reports have appeared as to the occurrence of asbestos. Data on the physical and chemical characteristics of the indigenous asbestos are scarce.

The object of the present paper is to report the chemical, X-ray and thermal properties of asbestos from Charsadda Tehsil, and Mohmand and Khyber Agencies.

Materials and Experimental Procedure

In Charsadda area deposits of asbestos are sporadically developed near the Qilla village (34°26' 71°46') about 8 miles from Tangi. The slip fibre asbestos veins are located between lamellar antigorite of serpentine rock mass, and are sometimes 10 inch thick. The country rock was most probably formed by the serpentization of dunite. Lenses of chrome ores are also found in the serpentine rocks.

Since 1964 the people of the nearby villages have been selling the asbestos to dealers in Peshawar. Mining methods are primitive. About 20 tons of asbestos is produced every month. The pits' mouth value of Qilla asbestos is about Rs. 120 per ton.

The occurrence of asbestos in the Khyber Agency was first described by A.L. Coulson. He noted small veins of slip fibre asbestos in limestone near the junction with an intrusive epidiorite on the side of the road from Char Bagh Fort (34°07', 71°07') to the Kafir Kot piquet post, but found it uneconomical. In spite of its uneconomic nature it has been used in Peshawar as a substitute of imported asbestos.

The sample from Mohmand Agency was collected by a tribesman. Its geology and extent is not known. The three samples examined were Chrysotile from Qilla, and tremolite-anthophyllite from Khyber and Mohmand Agencies (Table 1).

Chemical Analyses.—All the three samples were analysed by classical methods. Structural water of sample K1 was estimated by the Penfield tube method. This method gave low results for K1 and K3 samples. As the amount of carbonate mineral in K2 is low and is absent in K3, the loss on ignition minus absorbed water and carbon

<table>
<thead>
<tr>
<th>Samples</th>
<th>Source</th>
<th>Colour</th>
<th>Luster</th>
<th>Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>K1</td>
<td>Qilla, Charsadda area</td>
<td>Greenish white</td>
<td>High silky</td>
<td>Soft, Silky fibres, flexible weak threads, Chrysotile</td>
</tr>
<tr>
<td>K2</td>
<td>Char Bagh Fort, Khyber Agency</td>
<td>Light brown</td>
<td>Silky</td>
<td>Waxy, Thread-like, weak, Tremolite-anthophyllite</td>
</tr>
<tr>
<td>K3</td>
<td>New Dehrai Mohmand Agency</td>
<td>White</td>
<td>Silky</td>
<td>Waxy, Thread-like, very weak, Tremolite-anthophyllite</td>
</tr>
</tbody>
</table>
THE EFFECT OF VARIETY AND LENGTH OF STORAGE ON THE CARBOHYDRATE CONTENTS AND TABLE QUALITY OF SWEETPATATOES

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Experiments were conducted to determine if a relationship existed between the dry matter, reducing sugar, non-reducing sugar, total sugar, maltose, dextrin or starch content of sweetpotatoes and table quality. Raw and baked roots were sampled at harvest, after curing, and after 4, 13 and 21 weeks of storage at 60°F. Table quality was determined by a taste panel, and the softness by a penetrometer.

A significant negative correlation was found between the amount of starch and the degree of softness; it was positive in case of non-reducing or total sugar. The changes in the dry matter and carbohydrate contents of raw and baked roots during storage have been shown in the Tables.

Sweetpotato (Ipomoea batatas Poir.) varieties are generally grouped into two classes on the basis of their culinary and table qualities. The ‘yam’ type is known as the moist type of sweet potato due to its property of becoming soft and syrupy when baked, while the ‘Jersey’ type is known as the dry type because it remains relatively dry and firm after baking. Among the varieties of ‘yam’ type some become softer when baked or canned immediately after harvest, while others become suitable for table use after being cured or stored for several months. The table quality of sweetpotato is strongly influenced by the degree of firmness and consistency of the baked roots. This marked difference in table quality of different varieties has prompted many research workers to investigate into the material or materials responsible for the changes occurring during storage or during baking of the roots. Magoon and Culpepper found a higher content of dextrin and a large amount of sugar in moist, soft varieties. In the firmer varieties no dextrin was found in roots canned immediately after harvest but a small amount was found in cured and stored roots. Culpepper and Magoon postulated that the consistency of canned roots was directly related to the ratio of starch to moisture contents—the sweetness was affected by maltose; but during cooking no change in sucrose was marked.

Blackwell and Scott observed a significant correlation between starch content of roots and firmness as determined organoleptically, whereas Morris and Mann found very little relationship between the degree of sweetness and the actual sugar content. Woodroof et al. reported that as the storage period of the raw roots increased the table quality of the canned products became more desirable. Sistrunk et al. was of the opinion that the variety which converted a higher percentage of starch to reducing sugars during backing was smoother in texture; the firm textured varieties had a higher starch content. Regarding the effect of curing and storage conditions on the chemical constituents of sweetpotatoes, Morris and Mann reported that from the time of harvest to the end of storage period the dry-matter percent changed very little but the total sugar content almost doubled. It was also found that during curing and storage there was a loss in starch and an increase in sucrose. The texture and table quality of baked roots were also found to be affected by the conditions under which the roots were stored. Changes in the percentage of pectin, carotene, and ascorbic acid contents were also found to be influenced by the variety, and storage conditions.

**Materials and Methods**

Four varieties of yellow-fleshed sweetpotatoes, namely, Acadian, Heartogold, Unit-1, and Earlyport, grown at Chase, Louisiana, were used as the experimental materials. Among the four varieties Acadian is known to be a variety that becomes soft and syrupy if cooked immediately after harvest, while Earlyport becomes suitable for table use after being cured and stored.

Samples of raw and baked roots were taken for analysis at harvest, after curing and during storage. Curing of the roots was done at about 85°F and at a relative humidity of 85 per cent for 2 weeks. After curing the sweetpotatoes were stored in a room at 60°F and a relative humidity of 72%.

For baking tests an oven heated by natural gas was used. The thermostat of the oven was cali-

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EFFECT OF VARIOUS CARBON AND NITROGEN SOURCES AND CONCENTRATIONS ON THE GROWTH OF FUSARIUM DIMERUM PENZIG

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The effect of various amino acids and carbohydrates as sources of nitrogen and carbon respectively on Fusarium dimerum Penzig has been studied. Different concentrations of nitrogen and carbon were used. Neutral, acidic and basic amino acids and mono-, di-, tri- and polysaccharides were used. It was found that glycine gave the most profuse growth of the fungus at all concentrations and maximum growth was obtained at 0.1%. The growth thus was directly proportional to the concentration of nitrogen. Best growth in glycine may be either due to its simple structure, making the nitrogen easily available for growth or due to possible specificity of the fungus for glycine as compared to other nitrogen sources.

In case of carbohydrates, trisaccharide raffinose and polysaccharide, inulin gave better results than other carbohydrates. This behaviour may be due to two factors. As the results were taken after a period of 10 days, it is quite possible that in the initial stages of growth i.e. after 2 or 3 days, the growth may be more in monosaccharides than in tri- and polysaccharide. However, as the tri- and polysaccharide were hydrolysed by the fungus in due course and the sugar became more easily available for growth, the amount of growth increased rapidly. Secondly the possible specificity of F. dimerum for trisaccharide raffinose and polysaccharide inulin may also be responsible for this behavior.

Introduction

Availability of carbon and nitrogen sources are amongst the prime conditions besides suitable temperature, pH, humidity and environment for the growth and development of any type of microorganisms. Temperature affects growth, spore germination, reproduction and indeed all activities of the organisms but this again is valid under specified conditions of time, medium, aeration, moisture content, pH and the method of growth measurement.

Though numerous surveys of nitrogen nutrition have been made but without much conception of the physiological problems involved. Not all nitrogen sources are equally suitable for all fungi. Fungi may be specific in the nitrogen source they utilize. Steinberg made an extensive study of the growth of Aspergillus niger on 22 amino acids. Of these, seven acids, namely, alanine, arginine, aspartic acid, glycine, glutamic acid, proline and hydroxyproline, were excellent sources of nitrogen for A. niger. This is due to specificity of response to certain amino acids by a certain fungus.

Amino acids are assimilated at varying rates from a complex medium and they exist as free acids in the mycelium. Experiments of this type have shown that a given amino acid allows good growth of one organism and only little of another, but still we are unable to conclude whether this selective behaviour of the two organisms involved is due to permeability, enzymatic capacities or merely due to secondary problems.

Most investigators agree that glycine, aspartic acid, asparagine, and glutamic acid are most likely to support good growth of microorganisms. Though leucine is generally not an adequate source of nitrogen, it is one of the most easily utilizable amino acid for Trichophyton persicolor.

Regarding the utilization of carbon much valuable work has been done as compared to the utilization of nitrogen. Carbon is one of the most important elements used in fungal metabolism. It occupies a unique position in the metabolic pathway. It is also an integral constituent of fungal structure. The synthesis of complex compounds like proteins and nucleic acids in the cell and the accumulation of chitin and cellulose in their wall strongly confirms the necessity of carbon. Carbon also liberates a considerable amount of energy by oxidation which is one of the essential processes carried out into the organisms.

The multidimensional studies on carbon nutrition, its presence or absence and corresponding changes in the growth of the organism have opened a new avenue in fungal physiology. Though tremendous amount of work has been done on this subject, yet the method, technique and use of different carbon sources in same or in different media, has been a major controversy among fungus physiologists.
ANATOMICAL STUDIES OF COMMIPHORA MUKUL ENGL. AND THE LOCALIZATION OF GUMS, RESINS AND TANNINS

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The macro and microscopic characters of the leaf and stem of Commiphora mukul Engl., have been studied. The leaf and young stem are characterized by the presence of trichomes. The young stem has multicellular, glandular capitate hairs whereas the leaf in addition to such hairs possessed simple uniseriate hairs. The stem shows very prominent secretory canals in the cortex region and tannins in the pith cells. Leaf is dorsiventral and contains sphaerocrystals in the parenchymatous cells.

Introduction

Commiphora mukul (Hook. ex Stocks) Engl., Syn. Balsamodendron mukul Hook. ex Stocks is commonly known as Indian Bdellium tree (Guggal in Sindhi) is a member of Burseraceae family. It occurs in the arid rocky tracts of Rajputana, Khandesh, Berar, Mysore, Sind and Baluchistan. In Karachi it occurs in the hillocks of North Nazimabad, Manghopir, Country Club Road, Korangi and the adjoining areas. In the indigenous system of medicine the gum obtained from C. mukul is widely used for a number of diseases. It is a bitter stomachic, carminative, intestinal disinfectant and check for diarrhoea. It has also been recommended for bronchitis, whooping cough and pneumonia. It is also used as a mouth wash, gargle, for weak gums and chronic tonsilitis.

The present studies were made because of two main considerations. Firstly, information on the anatomical features of this plant was very meagre. Secondly, it was considered that if the secretory canals are located in a particular region of the plant, it might be possible to evolve a method for obtaining maximum quantity of gum. It was found that in this plant the large secretory canals were located in the cortical region. If this region could be separated from the adjoining tissues, it may be possible to obtain a large quantity of gum as compared to that obtained by making incisions on the stem.

Materials and Methods

The first collection of Commiphora mukul specimens was made from Korangi Creek and the subsequent collections from the vicinity of these Laboratories (Country Club Road), where it was found growing in abundance. This material included stem, leaf, flower and fruit. All these parts were fixed in Formalin Acetic Alcohol solution (F.A.A.) for microtome sectioning. After keeping the material for at least 24 hours in F.A.A., it was dehydrated by running it through alcohol-xylol series and embedded in paraffin wax (m.p. 56–58°C). The sections were stained with Safranin in combination with Fast-Green. Permanent slides were made by mounting the sections in Canada Balsam. In addition to microtome sections, hand sections of the fresh material were studied for anatomical details and microchemical tests. For the study of tissues comprising the vascular system, small portions of stem were macerated according to Jeffrey’s method (equal volumes of 10% chromic acid and 10% nitric acid).

To give a vivid picture of the arrangement of tissues photomicrographs of T. S. and L. S. of stem and diagrammatic illustration of T. S. of leaf were made. Camera Lucida drawings of the macerated vascular tissues were drawn to provide proper illustrations. Microchemical tests were carried out in accordance with the procedures of Gurr and Johansen.

Botanical Description

C. mukul is a small tree, 4–6 feet high with more or less ascending branches which generally end in sharp spines (Fig. 1). Leaves 1–3 foliate, leaflets obovate, nearly sessile, margin toothed (Fig. 2A-A). Flowers almost sessile, a few in each fascicle, unisexual or bisexual. Stamens are dimorphic, 8 (4 plus 4) in number. Ovary is bilocular with a simple style and slightly bilobed stigma. Calyx gamosepalous with four green sepals forming a cylindrical cup, glandular and hairy. Corolla gamopetalous with four, ligulate, brownish red petals, longer compared to calyx. The stem is covered by ash coloured bark which when becomes old peels off in thin papery rolls exposing the under bark. Yellowish-white viscous fluid exudes from cracks commonly formed in the bark or from incisions. This fluid hardens to reddish-brown masses.
PHARMACOGNOSTIC STUDIES OF MENTHA SPICATA L. IN RELATIONSHIP TO TWO OF ITS HYBRIDS M. PIPERITA L. AND M. GENTILIS L.

S. R. BAQUAR*

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(Received October 3, 1965)

The essential oil extracted by microdistillation from *M. spicata* L. and two of its hybrids *M. piperita* L. and *M. gentilis* L. was compared with Oleum menthae piperitae obtained from the market. The yield acquire per plant was found to be very low i.e. not exceeding 0.01–0.03 ml. The analysis of all the samples was made by gas-chromatograph. Chromosome counts showed *M. spicata* having a somatic number of 54 while *M. piperita* and *M. gentilis* had 48 and 72 chromosomes, respectively. An attempt has been made to establish whether there is any relationship between polyploidal class and their essential oil content.

**Introduction**

*Mentha* is known for its economic importance in perfumery and pharmaceutical industry as the main source of Menthol and Piperiton. The major components of *Mentha* oil are a principal ketone (menthon) and its related alcohol (menthol) and ester. This genus displays a very high degree of interspecific and intraspecific hybridization resulting into series of intermediate hybrids ranging between two parental pure species and distinguishing from one another in morphological habits, cytogenetical behaviour, polyploidy level and essential oil content.

In the light of the above fact it was found interesting to compare the essential oil of a pure species with that of its hybrids to see whether there is any relationship between polyploidal class and their essential oil content. *M. spicata* L. which produces two well-established natural hybrids namely *M. piperita* and *M. gentilis* was chosen for this study.

The essential oil was extracted from various individual plants of these species by microdistillation. These samples and the standard Oleum menthae piperitae obtained from the market were analysed by gas chromatography.

**Materials and Method**

The essential oil was extracted by microdistillation. The classical methods of distillation were not useful as the oil content available was not more than 0.01–0.03 ml per plant. The oil drop suspended in water was dissolved in pentane which was later separated in a separating funnel and used for gas-chromatographic analysis. The same plant material was used for the determination of the chromosome number which was used for the extraction of the essential oil. Chromosome counts were made from root-tips fixed in Navashin (1% chromic acid, 95% acetic acid and 40% formalin in the ratio of 10:1:4). The percentage of various substances present in the oil was calculated by measuring individual peaks of the Fractogram by means of planimeter. Peaks III/IV and VII/VIII comprised two peaks each which overlapped each other thus preventing their separation and making it difficult to say with certainty whether only one or the other or both substances are present in an individual. In certain cases, however, where it was possible to identify the substances, for example in Oleum menthae piperitae, it was not possible to evaluate their percentages separately. Peaks Ia, IIa, VIa, XIIa, XIIIa, XIV and XV are unknown while rest of the peaks have been identified by comparison with porsh and Farnow. A Perkin-Elmer Fractometer (Type 116 E) with a polypropylene glycol column (Type R) was used for microanalysis under the conditions described by Baquar and Reese.

**Systematic Position and Chromosome Number**

*Mentha spicata* is one of the six pure species of the Eurasian continent, the others being *M. pulegium* L., *M. aquatica* L., *M. arvensis* L., *M. longifolia* (L) Hud, and *M. rotundifolia* L. *M. spicata* produces hybrids with practically all the other species, but of these two interspecific hybrids namely *M. piperita* L. and *M. gentilis* L. are well established in nature and were therefore selected for the present study. *M. piperita* is a cross between *M. spicata* and *M. aquatica* while *M. gentilis* is a hybrid between *M. spicata* and *M. arvensis*.

**Results and Discussion**

The gas-chromatographic study in the present investigation has been used less as a medium for...
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