Report of the Scientific Program, 11th International Congress

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From Washington to New Delhi can now be measured in time, because it has taken three years for the 10th International Congress of Essential Oils, Fragrances and Flavours to metamorphose into the 11th International Congress of Essential Oils, Fragrances and Flavours. On November 11, 1989, all of the hard work and dedication of various committees over this three-year period converged to the nervous anticipation that the Congress was about to start.

Recalling similar anticipatory feelings at the opening of the 10th Congress, the various U.S. committee members in attendance at the Delhi Congress shared these moments in silence with our Indian cousins. But this worrying was all in vain because when congresses are planned and organized, their success is just a heartbeat away. However, it goes perhaps without saying that each congress has its champion and the Delhi Congress owes much of its success to the hard work and diligence of Mr. Sant Sanganeria (program chairman) and his able staff.

Unless such unsung heroes are recognized, the reason for success is not generally known. Virtually all of the foreign delegates at the Congress who had actively participated in the 10th Congress know this fact only too well. A single, tireless, tenacious person can make the difference between just acceptable and success.

Now let us turn to the Congress itself, but before describing the program, I would like to say that the selection of the Taj Palace Intercontinental Hotel as the center for the Congress was an excellent choice by the organizing committee. A meeting venue can make or break a conference, however, the closeness and size of the meeting rooms, the efficiently run audio-visual equipment, and the numerous people in attendance to answer and satisfy even the most minor of questions helped to make this Congress one of the more exciting meetings that this author has attended in many years.

It was interesting to hear the comments of many of the foreign delegates who were unsure of what the week had in store for them. Those of us who have had the fortune of having attended previous meetings in India knew that we were in for an exciting and profitable week.

The Congress opened with the usual batch of introductory speeches from the present chairman (Makund Shah) and past chairman (Tom Plocek), and the president of IFEAT (Dr. Wladyslaw Brud). Next, that grand old man of Indian Essential Oils, Professor S. C. Bhattacharyya, summarized the forthcoming scientific sessions. He was followed by the program chairman (Sant Sanganeria) who described the logistics of the daily and ladies programs.

The guest speaker, Dr. A. P. Mitra, presented an interesting discourse on essential oils and India's position in this industry. He was a little controversial when he inferred that natural materials were less toxic than synthetic materials, however, as all of us know, toxicity can only be discussed in combination with purity. It is my belief that this was the point that Mitra was trying to make, although he just did not explain it very clearly.

The opening session ended with an evening of dance and music by Ananda and Tanushree Shankar and their dance troupe. This music was an interesting combination of Western and Indian music with Indian dancing. All in all, it was a delightful and colorfully entertaining evening. This inauguration ceremony took place at the Hotel Ashok convention hall which was for all except those delegates that stayed at this hotel, a tidy bus ride away from the Taj Palace. (For those of you with whom I

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1. **Molecular Engineering for Sandalwood Aroma**
Sukh Dev (Delhi)

Professor Dev took us through an interesting chemical journey from 3,6,6-trimethylbicyclo [3.1.0]hexane-3-carboxaldehyde (abeocaranaldehyde), a rearrangement product of carene epoxide (a compound which is easily obtained from δ-3-carene—the chief component of Indian turpentine oil), to a variety of compounds that possess sandalwood aromas. Using the structural requirements of the Naipawer model, he was able to show how the newly synthesized compounds like 1'-(3-6,6-trimethylbicyclo[3.1.0]hex-3-yl)-2'methylpent-1'(E)-en-3'-ol have an aroma which is sandalwood-like in character.

2. **Biological Activity of Essential Oils and Its Possible Applications**
Wladyslaw Brud (Pollena-Aroma, Poland)

After a historical introduction, Brud described the therapeutic uses for essential oils. He also summarized some of the bactericidal and fungicidal properties of oils. He also touched on the use of essential oils in aromatherapy and human psychology. Much of what was presented was couched in folklore without presenting any concrete reasons or studies on the biological activity of oils. Nevertheless, it was an entaining and interesting lecture.

3. **Measurable Properties of Odours and Their Application for Structure Odour Relationships**
Peter Mueller (Givaudan, Switzerland)

After an interesting introduction in which odour was defined as being "a property of an object which allows living creatures to perceive and to characterize it by means of the sense of smell", Mueller described headspace aroma evaluation, GC sniffing techniques and the need to understand the term recognition threshold.

He further described the use of an olfactometer to measure the average recognition threshold of a wide variety of compounds. After describing the measurement of several hundred threshold determinations where $n>20$, Mueller described the use of threshold correlations to determine the similarity or dissimilarity between two compounds. It is assumed that a given "smeller" has generally the same sensitivity for similar compounds (odors) and dissimilar sensitivities for unrelated odors.

Finally Mueller showed how, through threshold correlation studies, some headway was being made in view of structure activity relationships of a variety of aroma-bearing perfumery components.

4. **Some Recent Development in Improvement of Agrotechnology of Essential Oil Crops in India**
A. H. Akhtar Hussain (Hamdard Research and Educational Institutions, New Delhi)

Hussain described the high yielding clones and hybrids of lemongrass, palmarosa, citronella, vetiver, *Mentha spicata* (spearmint), *Mentha avensis* var. *piperascens* (Japanese mint). Also through better agronomical practices the yield of oil per hectare for davana, lavender, clary sage and peppermint was increased. Finally, he mentioned that work is underway to promote an increase production in rose oil, geranium oil and patchouli oil.

5. **From Essential Oils to Tailor-made Fragrance Chemical Trends in the Production of Perfumery Raw Materials**
Ferdinand Naef (Firmenich, Switzerland)

Naef described the birth of a new perfumery raw material from the need for a specific odor-type to the market acceptance where parameters other than odor are becoming more increasingly important. Next, he talked about the value of essential oils as sources of individual natural chemicals, the importance of trace constituents, and the methods of component isolation.

He then took us through the synthetic chemicals that have been introduced into the marketplace over the past 20 years whose odor-notes can be classified as patchouli-like, sandalwood-like, rose-like and jasmine-like. He concluded his talk with a few thoughts to the future:

1. The company that can tailor-make specific fragrance chemicals will have a competitive advantage.
2. The method for designing new fragrance chemicals will be heavily influenced by the computers and the basic knowledge of the mechanisms of olfaction.
3. Essential oils will profit from biotechnology.
4. Complex essential oils rich in sesquiterpenes will have a better future than those which have simpler constituents whose structures are accessible by synthesis.

6. **Trends in Flavors and Fragrance Research**
Brian Willis (Quest, UK)

The initial part of this talk was devoted to the historical use of flavor and fragrance ingredients. A discussion of the advances in equipment and instrumentation followed this. Then Willis switched subjects and concentrated for the rest of his talk on the use of fermentation reactions and microbiological conversions of known materials to useful flavor and fragrance compounds.

(54%), methyl eugenol (18%); *O. gratissimum:* eugenol (75%), *O. canum*—a: camphor (553%); b: linalool (80%); c: citral a (32%), citral b (21%) and *O. basilicum:* methyl cinnamate (41-51%).

A final paper which contained considerable information on *Ocimum* oils was entitled **Profiles in Indian Essential Oils of Selected Oleaganous Botanical Species** *(A. K. Vimalan, K. Sadanandan, M. P. Philip, N. Natarajan, M. Murugesanand, N. P. Damodaran, International Institute of Ayurveda, Coimbatore, India).* This paper, which was presented by Damodaran, probably had the smallest audience of any of the papers presented at the whole congress. Nevertheless, the author presented data that showed the widest range in composition of *Ocimum basilicum, O. sanctum, O. gratissimum* and *O. canum.* He showed that oils of some strains of *O. sanctum* possessed isoeugenol as the major constituent. The existence of isoeugenol as a major constituent of any *Ocimum* oil has never been published before.

Garcia-Vallejo presented an interesting paper titled **Essential Oils of Genus *Lavandula* L. in Spain** *(M. C. Garcia Vallejo, I. Garcia Vallejo and A. Velasco-Negueruela, Department of Industrial Forestry INIA-CIT, Department of Botany, University Complutense, Madrid, Spain).* In this study, she showed the existence of numerous chemotypes of the *Lavandula* oils examined which can be summarized as follows: *L. angustifolia* ssp. *pyrenaica:* chf. 1. linalool/borneol and chf. 2. camphor; *L. latifolia:* linalool/1,8-cineole/camphor; *L. lanata:* camphor/lavandulol; *L. dentata:* chtyp A: 1,8-cineole/β-pinene and chtyp b: α-pinene/β-pinene; *L. multifida:* chf. 1. carvacrol/β-bisabolene, chf. 2. camphor, chf. 3. myrcene and chf. 4. 1,8-cineole; *L. stoechas* ssp. *stoechas:* chf. 1. fenchone/camphor, chf. 2. 1,8-cineole; *L. stoechas* ssp *sampaioana:* 1,8-cineole/fenchone/camphor, and *L. stoechas* ssp. *pedunculata:* 1,8-cineole/fenchone/camphor, *L. viridis:* chf. 1. 1,8-cinole/camphor, chf. 2. α-pinene and chf. 3. α-cadinol and *L. luisieri* rich in 1,8-cineole and an unknown alcohol and ester.

Over the past few years, the interest in tea tree oil has become quite fervent because of the renewed interest in it for its antimicrobial qualities.

A paper entitled **Plantations of *Melaleuca Alternifolia*—A Revitalized Australian Tea Tree Oil Industry** *(L. R. Williams and V. N. Home, McQuarie Univ, NSW Australia)* attracted a lot of attention by growers of various essential oil crops. Williams described how through selection and the use of appropriate agricultural practices, the industry is changing from a rather crude operation, to that of a modern industry.

Normally, traditional tea tree harvesting is done by felling a large tree in the wild. Under modern practices, tea tree is grown as a hedge crop with 25,000-35,000 seedlings to the hectare. Tea tree leaves can be harvested either as leaf clippings or as whole shrubs. Thus a plantation style agronomy as shown pictorially by the author has been developed.

A paper entitled **Biochemical Genetics of Essential Oil Compounds** *(C. M. Franz, Univ. Vienna, Austria)* reported on the qualitative and quantitative variance in chamomile *(Chamomilla recutita).* The author described experiments in which the main compounds present in the oil such as α-bisabolol, 5,6-epoxy-α-bisabolol, α-bisabolol oxide A, α-bisabolol oxide B and α-bisabolone oxide and chamazulene were shown to be genetically controlled. It is very evident that from the work of Franz, it would be possible to produce plants that possess an enhanced content of single components such as chamazulene and (—)α-bisabolol.

Chamomile was also featured in another paper entitled **Essential Oil Production in *Matricaria* Tissue Cultures Influenced by Different Chemicals** *(G. Petri, L. Kursinszki and E. Szoke, Semmelweis, Medical Univ., Budapest, Hungary).* In this paper, Petri showed that the amount of essential oil production in the herb of organized chamomile cultures was influenced greatly by the use of N-isopropyl benzimidazolium chloride, biguanidine or some substituted hydroquinones as growth regulators. Not only the quantity of oil was affected, but the relative ratio of the individual constituents varied dramatically.

In a presentation by Kane entitled **Rearrangement of α-Campholenic Aldehyde** *(C. G. Cardenas and B. J. Kane, SCM Glidco Organics, Jacksonville, USA)* the rearrangement of 2,2,3-trimethyl-3-cyclopentenylethanol (α-campholenic aldehyde) in phosphoric acid was reported. It was found that the major products of isomerization were β-campholenic aldehyde, cis-γ-campholenic aldehyde and trans-γ-campholenic aldehyde. Furthermore, the authors reported that a number of the synthetic sandalwood-like aroma chemicals like sandalore®, Brahmanol® and Bacdanol® underwent similar isomerizations.

Starting from (S)-6,5-dimethyl-5-methoxycarbonylmethyl-2-cyclohexene-1-one, Sakurai reported a **New Synthesis of (—) Khusimone** *(K. Sakurai, T. Kitahara and K. Mori, Takasago, Tokyo, Japan).* Because (—)-khusimone is both interesting as a perfume raw material and as an insect repellent, and because it contains the unusual dimethylmethylenetricyclo [6.2.1.0] undecane skeleton, much attention has been paid to its synthesis. The elegant synthesis presented achieved only a 6.9% overall yield from the 15 step reaction. However, Sakurai also described the electrolytic esterification of (+)-zizanoic acid followed by a Jones oxidation to give (—)-khusimone in high yield.

Unfortunately, the major source of (+)-zizanoic acid was vetiver oil. Nevertheless, the authors were able to compare the spectral characteristics of (—)-khusmone produced by both methods to prove that the first 15 step method was successful.

An excellent paper entitled **Sesquiterpenoids of Panax Ginseng C. A. Meyers** *(H. Iwabuchi and M. Yoshikura, SAN-EI chemical Industries, Osaka Japan)* was presented by Iwabuchi. In addition to characterizing the presence of β-panasinene, α-neoclovene, α-panasinene, β-neoclovene, spathulenol and neointermedeol, the author both characterized and elucidated the structures of panasinsanol A, panasinsanol B and ginsenol—new constituents to this oil. The authors demonstrated the value of 2-dimensional NMR (^1H—^1H, C—^1H and long range ^{13}C—^1H) and nuclear overhauser effect difference experiments to confirm structural elucidation.

Omata presented a paper entitled **The Odour of Lotus** *(Nelumbonaceae)* **Flower** *(A. Omata, K. Yomogida, S. Nakamura, T. Ohta, Y. Izawa and S. Watanabe, Shisheido Kanagawa, Japan).* The author reported that as the large stamen had a similar aroma to the whole lotus flower *(Nelumbo nucifer)*, it was used to prepare a hexane extract for analysis. Sixty-one compounds were identified by GC/MS in the extract many of which were aliphatic hydrocarbons (73%). The aroma significant compounds characterized were 1,4-dimethoxybenzene, limonene, linalool and terpinen-4-ol.

A paper entitled **Composition of the Root Essential Oil from *Pimpinella diversifolia*** *(A. B. Melkani, C. S. Mathela, V. Dev and A. T. Bottini, Kumaun University, Nainital, India, Cal. State Polytechnic University, Pomona and Univ. California, Davis, USA)* was presented by Dev. It was reported that 36 components were identified in the oil including 4-methoxy-2(E-3-methyloxiranyl) phenol angelate and isobutyrate, their unepoxidized precursors and the diangelate and mixed angelate isobutyrate esters of 2(E-3 methyloxiranyl) hydroquinone.

A paper entitled **Extraction of Volatile Compounds of Lovage Root, Celery Seed and Carrot Seed by Different Solvents** *(J-Q. Cu, F. Perineau, M. Delmas and A. Gaset, Laboratoire de Chimie Agroressources, Ecole Nationale Superieuere de Chimie, Toulouse, France)* was presented by yours truly as a surrogate author. In this study, the authors compared the yield on extraction of lovage root, celery seed and carrot seed using a variety of solvents. The authors recommended that 1,2,2-trichloro-1,2,2-trifluoroethane (or Freon 123) was the best solvent of choice prior to steam distillation to produce an essential oil. This choice of solvent is not recommended in light of the problems associated with the industrial use of all Freon solvents, in particular the highly chlorinated ones.

Ehret presented a very detailed examination on narcissus absolute entitled **New Organoleptically Important Components from Narcissus Absolute** *(Narcissus poeticus L.) (C. Ehret, P. Maupetit and M. Petrzilka, Roure, Grasse, France).* In this paper, Ehret described the characterization of 80 new minor components, 20 of which were found to be organoleptically important. Some of the important constituents were: β-ionone, 1,2-epoxy-β-ionone, (E)-2-dodecenal, (E,Z)-2,6-nonadienal, (E)-2-nonenal, p-menth-1-en-9-al, veratraldehyde, 2-amylfuran, epoxy-cis-ocimene, jasminlactone, phenylacetonitrile and mintsulphide to name but a few.

In his typical excellent form, Weyerstahl presented a paper entitled **Analysis of the Sesquiterpene Fraction of Cascarilla Oil** *(P. Weyerstahl, H. Marschall-Weyerstahl and E. Manteuffel, Technical University of Berlin, FRG).* Using ^1H-NMR, ^{13}C-NMR and MS, 18 sesquiterpene hydrocarbons and 22 oxygenated sesquiterpenes were characterized. The structure of the main compound known as "cascarilladiene" (eudesma-5,7-diene) has been unambiguously established. Some of the interesting oxygenated sesquiterpenes identified were: 5,6-epoxy cascarilladiene, cascarilladienone, cascarillafuran, cascarilla lactone (all with the eudesma-5,7-diene base structure), 1,11-oxidocalamenene, torilenol, β-dictyopterol, dihydro-α-bisabolol and β-cedren-10-ol.

A paper entitled **Volatile Constituents of the Essential Oil of *Cyperus scariosus* Tubers** *(N. Garg, L. N. Misra, M. S. Siddiqui and S. K. Agarwal, CIMAP, Lucknow, India)* was presented by Agarwal. Using a combination of GC, MS, ^1H-NMR, ^{13}C-NMR and IR, 19 constituents were characterized as components of this complex oil. In addition to the identification of cyperene (15.8%) and isopatchoul-4(5)-en-3-one (16.5%), 1-oxo-selina-4(14),7(11)-diene, selina-4,(5),7(11)-dien-12-ol and patchoulanol were characterized for the first time in this oil.

Kaiser presented the most interesting analysis of a plant volatile concentrate entitled **New Volatile Constituents of the Flower Concrete of *Michelia champaca*** *(R. Kaiser, Givaudan, Switzerland).* In his usual impeccable way, he described the characterization of numerous unusual components such as phenylacetaldoxime, α-ionone oxime, β-ionone oxime, dihydro-α-ionone oxime, dihydro-β-ionone oxime along with other nitrogen containing compounds never previously characterized.

Continuing with his work on non-volatile compounds in citrus oils, McHale presented a paper entitled **The Oxygenated Heterocyclic Compounds of Citrus Peel Oils** *(D. McHale, Cadbury Schweppes, UK)*. In this presentation, McHale demonstrated that the adulteration of all citrus oils could be monitored very easily by examination of their coumarin/psoralen ratios and their methoxy flavone ratios. He stated that in 1988, 30 percent of all of the citrus oils sampled at Cadbury-Schweppes were adulterated. He furthermore predicted that the use of precise ratios between the coumarins, psoralens and methoxy flavones would allow the unequivocal identification of geographical and seasonal authenticity of any citrus oil.

An interesting report entitled **Biosynthesis of the Constituents of Vetiver Oil. II. Nootkatane and Eudesmane Compounds** *(A. Akhila and R. S. Thakur, CIMAP, Lucknow, India)* was presented by Akhila. Feeding studies of vetiver roots under incubation conditions with ^{14}C and ^{3}H-labeled mevalonic acid were described. Washed roots were distilled using a Clevenger apparatus and the oil was subjected to a typical work up used to isolate acids ($NaHCO_3$) and carbonyls (Girrard T). The neutral oil was next chromatographed over activity II alumina from which 10 fractions were collected using gradient elution.

Each fraction was further subjected to multiple $AgNO_3$-silica gel column chromatography and TLC to eventually yield pure materials. The isotope ($^{3}H/^{14}C$) ratio was then measured in all of the isolated compounds. Finally, the authors speculated upon the possible biosynthetic mechanisms thought to take place to produce certain eudesmane and nootkatane based compounds.

Komae presented a paper entitled **Gel Permeation Chromatography of Mono- and Sesquiterpenes** *(H. Komae and Y. Hayashi, Hiroshima University, Japan)* in which he described the use of an uncommon technique for the separation of compounds in the non-aqueous phase. He demonstrated how to separate classes of compounds according to whether they were linear, monocyclic, bicyclic, tricyclic or tetracyclic. Also, Komae showed that the separation was independent of functional group. The technique adds a separation parameter for the essential oil chemist hitherto before rarely encountered.

In a continuance of his work on CO_2 extraction, Moyler presented a paper entitled **CO_2 Extraction of Essential Oils** *(D. A. Moyler, Felton International, Milton Keynes, UK)* in which he described the use of this technique to extract cardamom, celery seed and black pepper. Although the author described the use of both supercritical CO_2 >80 bar and subcritical CO_2 <80 bar or liquid CO_2 extraction, he noted that with supercritical, the extraction is more complete (more like a concrete) as compared to the liquid CO_2 extraction.

Careful reduction of the pressure of a supercritical extract dissolved in CO_2 from 200 bar to 80-100 bar allows the essential oil (without the resinous components) to be fractionated from the system. If a similar subcritical extract is made (at 50-80 bar) that requires some fractionation to remove undesirable components, then ultra high vacuum molecular distillation is the favored fractionation procedure.

Boelens presented a paper entitled **Ten Years of Hydrodiffusion Oils** *(M. H. Boelens, F. Valverde, L. Sequeiros and R. Jimenez, Distilaciones Bordas Chinchurreta, Seville, Spain)* in which he commented on the essential oil composition of steam distilled oil versus hydrodistilled oil obtained from a variety of raw materials. He showed that the differences between the chemical composition and olfactive/organoleptic properties of an essential oil obtained by hydrodiffusion and steam distillation were directly related to the type of oil glands present in the plant material.

For example, oils produced from raw materials with isolated oil cells by hydrodiffusion, were found to contain a higher concentration of oxygenated monoterpenes and aromatic compounds and possess more preferable olfactive/organoleptic properties than steam distilled oils. Plant material with oil present in cavities yields an oil by hydrodistillation or steam distillation from plant materials which possess glandular hair oil glands were found to be very similar.

It is possible to assess the value and appeal of a meeting from the number of participants who were registered and in attendance. In Delhi, there were about 1300 participants. The host country (as is usual) had the largest contingent (>500). However, among the 48 other countries represented, there were contingents in excess of 30 from Japan, France, USA, UK, and the Federal Republic of Germany. Also, it is worth noting that this was the first time that Nepal and Vietnam have been represented at one of the International Congresses. As a result of such a turnout, it can be considered that the 11th Congress was a resounding success.

We now have to wait another three years for the 12th International Congress of Essential Oils, Fragrances and Flavours to move back to Europe more specifically Vienna, Austria. Hope to see you there! P&F