

A. catechu in ethanol was confirmed by Reena R. Nelson (P.S.G. College of Arts and Science, Coimbatore). Further, the positive effect of arecanut extract on learning and memory in rats using eight-arm radial maze led M. P. Joshi (Goa College of Pharmacy) to hypothesize that arecanut extracts could control schizophrenia symptoms and also have a positive effect on Alzheimer's disease.

Another feature of arecanut is its antimicrobial properties. When arecanut extract was used as root-canal irrigant, it significantly brought down the population of *Enterococcus faecalis* and suppressed oral bacteria such as *Streptococcus mutans*, *S. salivarius*, *Candida albicans* and *Fusiform nucleatum*. This encouraged N. Malathi (Sri Ramachandra Medical College, Chennai) to recommend arecanut extract to be a component of toothpaste for preventing oral diseases. Similar observations were made by Rekha Rai (KSHEMA, Mangaluru) who reported suppression of *Pseudomonas aeruginosa*, *Candida albicans* and *Enterococcus faecalis*. She suggested the extract spray can be used as hand disinfectant or hospital sanitizer.

In the epidemiology session, A. Ruckmani (Chettinad Hospital and Research

Institute, Chennai) reviewed the last 10 years' publications and found some limitations regarding the research projects conducted so far – most of them were *in vitro* on cultured cell lines or animal studies. The methodical and technical gaps in such publications were highlighted by S. Keshava Bhat (Arecanut Research and Development Foundation, Mangaluru) and Ravichandra (KSHEMA). A recent pilot survey conducted in Karnataka did not show any harmful effects of arecanut chewing on human health (C. T. Jose, CPCRI, Vittal).

Speaking at the valedictory session, K. Satyamoorthy (Manipal University) and Vijayalakshmi Deshmane (formerly with Kidwai Memorial Institute of Oncology, Bengaluru) mentioned that arecanut is a good source of phytochemicals and can be a treasure trove for substances of pharmacological interest. They opined that further research is needed on the biomedical and psycho-social consequences of areca usage.

K. N. Bhat (Advocate, Supreme Court of India) who delivered the valedictory address, was convinced that arecanut does not have negative effects and urged all those concerned to compile evidence-based research reports and file an affida-

vit with the Central Government at the earliest.

The majority of medical practitioners were of the opinion that reports on the effects of arecanut consumption on human health are only observational and not based on any systematic scientific studies. Arecanut was also described to possess antimicrobial properties and reduce digestive disorders, diabetes, and depression. Most of the findings were *in vitro* or animal studies. However, it was recognized that all the health benefits listed require systematic research and clinical trials and need to be published in reputed journals. A multi-institutional project involving basic and strategic, biochemical, cell line and clinical research was suggested to understand the effects of arecanut consumption in various forms on human health. Preclinical and clinical trials for the development and discovery of new drugs, possible therapeutic effects and toxicity were also discussed.

P. Chowdappa, K. B. Hebbar* and **S. V. Ramesh**, ICAR-Central Plantation Crops Research Institute, Kasaragod 671 124, India.

*e-mail: balakbh64@gmail.com

MEETING REPORT

Modern techniques for molecular and morphological characterization of crustaceans*

Taxonomy is one of the oldest branches of science, dating as far back as the human language itself. It has significantly advanced from Aristotle to Linnaeus, and since the modern Linnaean system, many taxonomists have emerged. Molecular techniques have been added to modern taxonomy in recent times. However, at

present, the number of taxonomists has dwindled, and this has resulted in a greater number of unknown, undescribed organisms. To address this taxonomic impediment, a two-week long international workshop on modern techniques for molecular and morphological characterization of crustaceans was recently organized. The primary aim of the workshop was to train researchers in modern taxonomic techniques and create a network of crustacean taxonomy experts in India, which is a small group at present. It encompassed talks, practical sessions as well as field trips regarding various aspects of crustaceans. Experts from Germany, Japan, Malaysia and India

trained a group of 25 students with varying degrees of knowledge on crustaceans and taxonomy. Subject experts addressed important crustacean taxonomy topics during the workshop.

Morphological characterization is the first step towards identifying a species, and the oldest way of taxonomy. Identification by morphology of prawns, crabs, lobsters, isopods and copepods was taught with great fervour, and pictorial representations as well as handling of the specimens. K. Valarmathi (Zoological Survey of India, Kolkata) and B. Vaseeharan (Alagappa University, Karaikudi) conducted lecture sessions on the identification of freshwater prawns and

*A report on the International Workshop on 'Modern techniques for molecular and morphological characterization of crustaceans', held during 25 June to 6 July 2018. The workshop was organized by the Centre of Advanced Studies in Marine Biology, Annamalai University and sponsored by the Ministry of Earth Sciences, New Delhi.

paenedian shrimps respectively. Intensive sessions, including lectures and practical sessions on parasitic copepods were conducted by Daisuke Uyeno (Kagoshima University, Japan) and B. A. Venmathimaran (University of Malaysia, Sabah). For the practical sessions, samples of various fish were collected from a local fish landing centre, brought to the laboratory and scanned for parasitic copepods. Once the copepods were located on the fish body, participants were made to mount them on microscopes and identify the species with the help of reference material. C. O. Coleman (Museum of Natural History, Berlin) provided the participants guidelines on how to preserve samples correctly and store them. Various preserved specimens of prawns, lobsters, crabs and parasitic isopods were displayed to understand how each species differed morphologically.

Importance was also given to field visits, wherein small day excursions to various sites were conducted to understand on-field identification and collection techniques. The local fish landing centre was visited, where the daily catch was analysed for various crustaceans. Different species of crabs, lobsters and prawns were identified on the field with the help of morphological characters. Visit to the Pichavaram mangroves was organized, where the participants could better understand the habitat and ecology of crabs in mangrove ecosystems. L. Sivakumar (Annamalai University, Parangipettai) emphasized on the importance of mangrove ecosystems, and provided an easy way to identify mangroves based on their morphology. The Pichavaram mangroves are the world's second largest mangrove forest by area. There are 11 species of mangroves in Pichavaram, including one of the most peculiar species, *Rhizophora annamalayana*. This mangrove is a hybrid between two mangroves, viz. *Rhizophora apiculata* and *Rhizophora mucronata*.

Morphological characterization of all species is not always possible as some closely related species do not differ morphologically. Modern taxonomy went through a revolution when molecular techniques were invented. Nowadays, identifying a species by its genomic structure is considered more effective than morphological taxonomy. However,

taxonomy at the molecular level cannot be independent of morphological characterization. With this message, the participants were taught molecular techniques for the identification of crustaceans. A case study was presented by Anup Mandal (Rajiv Gandhi Centre for Aquaculture (RGCA), Sirkali), on the genus *Scylla* of mud crabs. Records suggested the presence of four crab species in India. The four crabs showed little morphological differences. However, molecular characterization showed that only two species in *Scylla* were found in India. The molecular genetics result was supported with one morphological character distinguishing the two species. A day-long hands-on training session was held at RGCA on molecular techniques for species identification. The participants were taught sample collection, obtaining muscle/blood samples from fish and crab, DNA extraction using the samples and PCR and DNA sequencing. Although the session was only for a day, it was informative as immense knowledge on molecular techniques was shared.

As technology advances, so does the science of taxonomy. Modern techniques make use of computers to make species description a simpler job. Two essential methods were taught during the workshop, viz. DELTA (Description Language for Taxonomy) and digital drawing. DELTA is a tool used to record taxonomic details of species. Taxonomic information on various species can be stored into DELTA and then presented as descriptions in the form of text. The information can also be used to develop conventional keys for various taxa, thus helping in species identification. The concept of interactive keys is recent, where illustrations or images are used to identify species. Every morphological character or taxon is assigned an illustration or image, which is then used to develop an interactive key (INTKEY). The illustrations used for such keys are usually detailed, especially in organisms such as crustaceans where appendages, spines and other body parts are used for morphological characterization. Therefore, it is necessary that the illustrations are in detail and high quality. Digital drawing is a technique through which high-quality illustrations can be made. It is done through a process of drawing the

organism and eventually digitizing the drawing. Pencil drawings of the specimens can be done using a microscope and a camera lucida. These are then scanned and digitized using software such as Adobe Illustrator. In the practical sessions, Coleman taught the participants how to use DELTA to prepare taxonomic descriptions, conventional keys and interactive keys. A session was held on digital drawing with the use of Adobe Illustrator. These techniques will come in handy when one chooses to work on the taxonomy of any organism.

Besides molecular and morphological characterization, sessions were also held on crustacean species of economic importance. A visit to a crab-fattening centre was arranged where Gopalakrishnan (Annamalai University, Parangipettai) demonstrated how the crabs were made ready for export. Crab fattening is an important alternate livelihood for people in the coastal regions of India. Culturing of the commercially important artemia or brine shrimp was also taught to the participants by K. Balachandar (RGCA). Artemia is a live feed used in many aquaculture farms. Other relevant topics such as biodiversity assessment, IUCN status assessment and data analysis were also covered during the workshop.

Over the two weeks, the participants and experts managed to interact at great lengths on varied topics. The workshop provided a crucial platform for crustacean researchers all over India to connect and network with experts from various parts of the world. The participants were from diverse fields, including some with expertise regarding crustaceans. The workshop proved to be a vital stepping stone for those wanting to take up research on crustaceans as well as taxonomy.

ACKNOWLEDGEMENTS. I thank Manchi Shirish S. (Sálim Ali Centre for Ornithology and Natural History) for providing me the opportunity to attend this workshop. I also thank the Ministry of Environment, Forest and Climate Change, Government of India for funding the project.

Amruta Dhamorikar, Sálim Ali Centre for Ornithology and Natural History, Anaikatty Post, Coimbatore 641 108, India. e-mail: ahdhamorikar@gmail.com