8th International Conference on Mushroom Biology and Mushroom Products held in New Delhi (19-22 November 2014) - A Report

Manjit Singh and Shwet Kamal*

ICAR-Directorate of Mushroom Research, Chambaghat, Solan (HP)- India
Corresponding author, E-mail: shwetakamall@gmail.com

Mushroom Research in India began in the 60s in the states of Himachal Pradesh and Jammu & Kashmir, and remained confined to these states with focus only on white button mushroom. The National Centre for Mushroom Research & Training (NCMRT) now known as ICAR-DMR was established in 1983 under the auspices of the Indian Council of Agricultural Research. In India, mushroom production systems are of mixed type i.e., both seasonal as well as high-tech cultivation. Although mushroom production in the country is at a young stage, growth rate, both in terms of productivity as well as production, has been phenomenal. The current production is over 120,000 tonnes with the button mushroom holding a major share. About 10-15% of button mushroom production is through seasonal cultivation in huts while the remaining production is under controlled conditions. The cultivation of other mushrooms like oyster, paddy straw and milky mushroom is mainly seasonal.

To upgrade our knowledge across the globe on mushrooms, International collaboration is especially needed in the areas of germplasm conservation and maintenance, genetic improvement, cultivation aspects, nutritional and nutraceutical properties, etc. It was really overwhelming for us to hold the 8th International Conference on Mushroom Biology and Mushroom Products (ICMBMP) in India. It was a great opportunity to interact and learn new horizons of mushroom science with researchers from around the world. The 8th ICMBMP was hosted in the historic city of Delhi, India at the National Agricultural Science Centre Complex from 19-22 November 2014.
The conference, with 70 participants from 26 countries from outside India, including about 150 scientists, 40 entrepreneurs, 30 farmers and 20 students from India, was held for four days with multifarious activities ranging from oral presentations, poster presentations, exhibitions, scientists-farmer interaction, a field visit, and networking. The 8th International Conference on Mushroom Biology and Mushroom Products included one theme lecture, 13 keynote addresses, 63 oral and 128 poster presentations covering diverse topics such as mushroom diversity, genetics, biochemistry, biology & development, medicinal aspects, value addition, economics of mushroom production, etc. The topics were divided into ten sessions.

The conference started with registration and networking on 19th November 2014 followed by a conference dinner. The conference was inaugurated by Dr. S Ayyappan, Secretary, Department of Agricultural Research and Education (DARE), Government of India & Director General, Indian Council of Agricultural Research (ICAR). Deliberations began with a theme lecture by Dr. Daniel J. Royse, USA, where the present status of mushrooms in different parts of the world and the changes that have taken place during last few decades were presented. The growth in production of king oyster in last few years in China and Japan has really changed the production

Fig 2. Inaugural function of 8th ICMBMP at AP Shinde Auditorium, NASC complex, New Delhi

Fig 3. 8th ICMBMP Delegates from China
scenario and has brought oyster mushrooms as the second most important commodity among different mushrooms.

The presentations on Biodiversity and Taxonomy was a journey through various parts of India like the Himalayas, North western plains, central India, western ghats, North East, the Indian desert, Kashmir, Maharashtra, etc. In addition, there was an opportunity to look into the diversity of medicinal mushrooms in Italy and their conservation, the ethnomycology of a volcano reserve in Mexico, and the mushroom diversity of Ghana and Kenya, etc. In nutshell, the conference provided an opportunity to view the spectrum of diversity in different continents, their value, conservation, etc. There is an enormous diversity in tropical and subtropical parts of India and also the hilly regions and there is a need to document and characterize this for posterity. It is time that we place emphasis on ethnomycological aspects and collect, document and conserve as much as possible before both knowledge and diversity is lost.

The discussions on molecular biology and genetic improvement helped us to understand the status of variability in different mushrooms like *Agaricus*, *Pleurotus*, *Volvariella*, *Ganoderma*, *Schizophyllum*, etc. and also the application of modern techniques in development of improved strains. Dr. Sonnenberg discussed the tools and techniques in genetic improvement in the button mushroom. There is much hope to exploit and characterize the diversity for its utilization to produce quality mushrooms and use others for developing various products of nutraceutical and medicinal value. Mushrooms growing in unique niches have evolved various survival mechanisms, some of which convert inorganics into nanoparticles that leads to change in their toxic properties. Dr. Absar Ahmed illuminated this aspect through his work done on production of nanoparticles.
using various endophytic, disease causing and thermophilic fungi, and mushroom extracts. Bioinformatics is going to play an important role in understanding applications of biology. The presentations on whole genome sequence of *Volvariella*, WRKY transcription factors in button mushroom, and transcriptome analysis in *Lentinula* has paved the way for future applications. Understanding fundamental pathways and developmental processes in edible fungi is important for generating new applications and finding new vistas. The session on biology, biochemistry, physiology and development provided an opportunity to discuss fungal nonspecific peroxygenases, genetic transformation of mushroom, lignocellulosic enzymes, laccases, glutamate d-carboxylase and various other enzymes with respect to their functions and gene expressions. The study and purification of various polysaccharides, lectins, glucans, phenolics, dyes from edible mushrooms like *Agaricus*, *Pleurotus*, *Hypsizygus*, *Psathyrella*, *Coprinus*, *Morchella*, *Calocybe*, *Lenzites* etc., and their effects helped in comprehending the current status. The use of marine fish waste in mushroom cultivation was another non-conventional topic. Utilizing raw materials effectively and producing quality seed for higher productivity will continue to remain a primary area and attract maximum contributions. The present conference was no exception and we had four keynote lectures, ten oral and 35 posters listed for presentations and discussions in this area. Understanding cultivation methods of shiitake, biotechnological potential of oyster, biochemical features of substrate degradation and correct methods of spawn production set the tone for discussions. Various aspects of button mushroom like biological efficiency of wild types, use of thermophilic fungi in compost, metagenomic profiles of bacterial communities in casing, new methods of irrigation, etc., were discussed. The number of papers dealing with *Pleurotus* spp. dealt with vegetative growth on different substrates, quality attributes, bioremediation, cultivation of different species and improvement, such as spore deficient strains. *Lentinula*, *Volvariella*, *Tuber*, *Calocybe*, etc. also attracted the attention of researchers with respect to various cultivation aspects. The stage is set for mushroom diversification.
Fig. 9. Dr. John Buswell, UK delivering keynote during waste conversion session

Fig. 10. Dr. Magda Verfaillie, Belgium delivering keynote during waste conversion session

Fig. 11. Prof. Tan Qi, China delivering keynote during waste conversion session

Fig. 12. Dr. Johan Baars, Netherlands delivering oral presentation during waste conversion session

Fig. 13. Dr. Ye Caiyun, China delivering oral presentation during waste conversion session

Fig. 14. Dr. Ofer Danay, Israel delivering oral presentation during waste conversion session
The discussions on mycomolecules and medicinal properties attracted the attention of researchers and set the tone for discussion by keynote lectures on advances in cultivation of medicinal fungi and production of compounds in bioreactors, and also potential of mushroom bioactive molecules in development of different healthcare products. The work done on the role of polysaccharides in oxidative stress in diabetic rats, antioxidant properties, mitochondrial dysfunction, cardio-protective antitumor hypolepidemic, antioxidant properties were some of the topics of discussion based on the compounds from Calocybe, Fomitopsis, Lentinula, Auricularia, Ganoderma, Hypsizygus, Pleurotus, Antrodia, Termotomycetes, Cordyceps, etc. The status of mushroom research in Sri Lanka was also presented during the session.

Mycorrhizal, entomopathic and other novel mushrooms will continue to remain important and the Cordyceps group is an important component. Applications like dyes from Pycnoporus, biocontrol using Trichoderma and toxicological studies on Inocybe were some of the areas covered in addition to the basic studies on Termotomycetes and other novel fungi. Studies on newer mushrooms like Agrocybe, Lentinus squarrosulus, Cordyceps tuberculata,
Calocybe gambosa, Astraeus hygrometricus, Trametes spp., Psathyrella and Agaricus subrufescens were also discussed during the session.

Pest and diseases are an integral component of any biological system and mushrooms are no exception. However, the emphasis seems to be shifting from biocontrol agents and IPM with greater emphasis on hygiene and pasteurization. Infection of Cladobotryum mycophilum on Agaricus and Pleurotus crops in Spain, the effect of essential oils on mycopathogens, and integrated approaches to control Mycogone perniciosa in Agaricus crops were some important highlights of the session. In addition, strategies for control of insect pests, nematodes and diseases of button and the paddy straw mushroom were also discussed during the session.

Mushroom fortification and development of products is an ongoing process and an important component for popularizing mushrooms. There were number of presentations relating to nutritional values, cooking, packaging, shelf life and various other products.

The role of IT in mushrooms is projected as an important area in the future. The changing global scenarios with respect to availability of substrates, labor, etc. are going to impact the

Fig. 19. Dr. Andras Geosel, Hungary delivering oral presentation during Pest and diseases session

Fig. 20. Dr. John Buswell with the Lifetime achievement award (Dr. Jose Sanchez, Dr. Tan Qi, Dr. Shwet Kamal, Dr. Nelson Colauto, Dr. Manjit Singh, Dr. John Buswell, Dr. Anton Sonnenberg, Dr. Andras Geosel and Dr. Daniel J Royse-left to right)
economics and marketing of mushrooms. The discussion of these aspects was focused on India and was supplemented through interactions in the scientist-farmer-interface.

Thus, a wide spectrum of issues ranging from diversity to applications were discussed and the discussions on mushroom biology and mushroom products will help in promotion of the growth of mushrooms across the globe and will also pave the way for generation of more basic knowledge that will be essential for continued growth. All discussions of the conference have been summarized in the form of an Abstract book and two volumes of Proceedings. The same is available on the society website of WSMBMP (www.wsmbmp.org).

The conference ended in the afternoon of 22 Nov 2015. It was a suitable occasion to acknowledge the contributions of a legend, Dr. John Buswell, to the world of mushroom science by conferring him Outstanding Researcher Award. The award ceremony was followed by a field visit to nearby seasonal mushroom farms at Sonepat (Haryana) that collectively contribute about 10% of the button mushroom production of India (rest being from environment controlled units). In the evening of the previous day i.e., 21st Nov 2014, a general council meeting of World Society of Mushroom Biology and Mushroom Products was held and new councilors were elected.

The successful completion of the conference depended mostly upon the participants and contributors. We would like to acknowledge the contribution of all keynote speakers and presenters, without which this conference would not have been a success. We would like to thank

Fig. 21. The team of Directorate of Mushroom Research – The organizers of 8th ICMBMP (Front row Left to right- Dr. RC Upadhyay, Ms Mamta Gupta, Ms Bindvi Arora, Prof. Susanna Badalyan, Dr. Manjit Singh, Dr. VP Sharma, Dr. Satish Kumar; back row left to right – Dr. OP Ahlawat, Mr. Mahantesh Shirur, Dr. KK Janardhanan, Dr. Shwet Kamal and Dr. Yogesh Gautam)
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