

**Shri AMM
Murugappa Chettiar
Research Centre**

M C R C

*where technology meets nature and
connects rural India*



ABOUT THE ORGANIZATION

Shri A.M.M. Murugappa Chettiar Research Center (MCRC), a non-profit research organization, was established in 1973 and has been registered under the Societies Registration Act 1860. MCRC has been recognized as a Research and Development organization by the Department of Scientific and Industrial Research (DSIR), New Delhi, Government of India. MCRC is governed by a governing Board composed of experienced Scientists, Engineers, Management experts and Educationalists. The center has been recognized to conduct Ph.D. programs registered with the University of Madras. Donations to the Center are exempt from income tax under Section 35 1(ii) of the Income Tax Act.

MANDATE

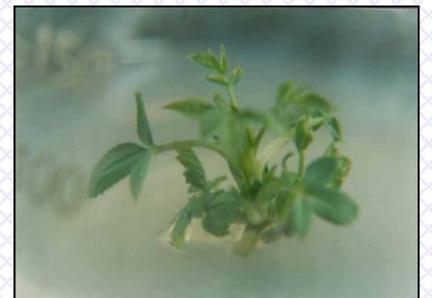
The ideologies of MCRC are centered at developing technologies and their dissemination to rural applications to promote the living standards of people belonging to the rural sections of the society. The philosophy guiding research at MCRC has been to develop solutions to problems in society using scientific methodologies and innovating appropriate devices. The problems tackled have been the ones considered relevant to the society. The registered mandate of the Center, however, permits it to work on other problems as well.

FACILITIES AND INFRASTRUCTURE

Situated in a 5-acre campus at Taramani, adjacent to the CSIR complex, this center has all facilities, including well equipped laboratory for research in all aspects of microbiology, biotechnology, biochemistry, soil analysis, and has a full-fledged workshop to device gadgets for rural applications. Some of the instruments that the center has include HPLC, GC, UV-VIS Spectrophotometers, Lyophilizers, Fermentors and Bioreactors. More than 15 Personal computers with UPS systems have been installed at the center and 12 of them have Internet connection.

RESEARCH AREAS AT A GLANCE

In an era where environmental issues are of prime concern, MCRC has developed sustainable technologies and made its presence felt in a number of thrust areas that include Biological agriculture & Horticulture, Wasteland Development, Creating shelter belts, Resource Conservation and Utilisation, Biofuels (Alcohol, Hydrogen and Methane), Plant biotechnology, Health & Nutrition (Spirulina utilization), Paper from alternate materials, Microbial pigments, Mushroom production, Natural dyes, Biofertilizers, Biopesticides, Organic farming and Alternative green houses, Utilization of seaweeds in environmental and biotechnological applications, screening of macroalgae, Biodiversity and bioprospecting of bioresources, charcoal briquetting, Collection of germplasm and clonal propagation of medicinal plants, in addition to Engineering Devices for Rural Applications viz., Windmills, Solar & Thermal Devices, and Surveys/Resource mapping. The R & D component of MCRC can be broadly divided into two categories. They are Biotechnology or Biological sciences and Engineering and are further discussed below.



BIOTECHNOLOGY

I. Food and nutrition

Spirulina

One of the major research programmes undertaken at MCRC on Algal technologies was on *Spirulina* and this, after years of intensive research, had brought recognition and accolade for MCRC. *Spirulina* is a wholesome food supplement rich in β -carotene, phycocyanin, linoleic acid as well as many vitamins and minerals. *Spirulina* could be cultivated easily. MCRC had established all the needed technologies for mass cultivation, harvesting, drying and even packaging of *Spirulina*.

The world's largest feeding trial with *Spirulina* was conducted by MCRC. Nearly 5,000 pre-school children were fed with a special formulation of *Spirulina* alga over a period of 18 months. Medical reports confirmed that it was a useful supplementary vitamin A diet.

MCRC has extended the *Spirulina* production technology to the villages by training the rural people, especially women, to grow this alga in their backyards for nutrition. MCRC with the financial support from DBT, Govt. of India has assisted in rehabilitating the earthquake-stricken villagers of Latur, Maharashtra by introducing this technology for income generation.

Mushrooms

Mushroom production for additional income generation to farmers has been one of the programs undertaken at MCRC. Dissemination of this technology to rural population including poor farmers and women in Sevapur, Karur district, Tamil Nadu has been one of the activities of the center. In addition to imparting the techniques of mushroom cultivation research is also being conducted on the efficacy of different agricultural residues as raw materials for mushroom cultivation. Both oyster mushroom and button mushrooms are grown here. Though mushrooms have high protein content they are not popular in India and MCRC is taking all efforts to create awareness through various training programs and workshops.

II. Environmental clean-up

Seaweeds as biofilters

MCRC has initiated research programme on cultivating marine algae to be used as biofilters of shrimp aquaculture wastewater. Research included studies on uptake of excess chemicals present in the effluents by macroalgae (red, brown and green algae) as nutrients. Laboratory methods have been standardized for the extraction of Agar agar from *Gracilaria edulis* and *G. verrucosa*.

Polyhydroxyalkanes

Work on the synthesis and accumulation of polyhydroxybutyrate, used extensively in the production of biodegradable plastic, has been progressing with bacteria from non-saline environments, at this center during the past few years. Innovations in the production process and laboratory scale separation of polyhydroxybutyrates are underway.



Textile dye effluent treatment

MCRC has devised a novel method for treating effluents from textile dyeing industries using a variety of microorganisms. Detailed laboratory studies showed that these dye-eating bacteria are all non-pathogenic, obligate saprophytes forming part of the normal soil microflora. Some of these bacteria when used as consortia, were found to be more effective in degrading and decolorizing textile dyes, than when used individually. Studies on different aspects of this problem will continue.

Paper mill effluent treatment

Most of the paper mills still follow the conventional mechanico-chemical pulping and release various forms of pollution. While we are researching on biopulping and biobleaching we are also concentrating on treating the paper mill effluents.

III. Organic farming

MCRC has been practicing organic farming right from its inception in 1973 under Dr. C.V. Seshadri, our first Director. In recent years, organic manure has been in sharp focus due to the pollution caused by repeated application of chemical fertilizers. Large amounts of organic matter are generated from agricultural activities, dairy farms and animal shelters. These valuable but misplaced resources could be utilized by degrading them scientifically into nutrient rich organic manures. We are practicing both anaerobic (**Farmyard Manure**) and aerobic (**NADEP & Vermicomposting**) composting methods.

Biodynamic agriculture

Biodynamic composting is a method of producing organic manures, the underlying principle of which is the development of quality humus out of dead organic materials. The biodynamic process specifies eight preparations to produce biologically active humus. Incubation of these preparations for composting is done in the hollow of cow horns.

Permaculture

Permaculture or permanent agriculture, a cultivation practice of Australian origin most suited to Indian Edaphic and climatic conditions, is promoted by MCRC for a long time. Multi-species windbreak system, intensive cropping and multi-tier planting are part of this system. Crop rotation with vegetables and other crops are practiced in permaculture, at MCRC.

Biofertilizers

Biological Nitrogen fixation and solubilisation of phosphates and potassic compounds are treated as very important components of the organic farming technology. MCRC through collaborative research programmes has assisted the Tamil Nadu Forest Department in mass production of specific microbes including diazotrophs for improved survival and growth of tree legumes in afforestation programmes and also for quicker establishment and faster growth of sandal trees in new plantations. Studies on various Biofertilizers, formulations and application methodologies will be the focus of our future research.



***Biopesticides, Kitchen gardening, Wasteland development, Shelter belts* are other programs of MCRC involving organic agriculture.**

IV. Plant tissue culture

Plant tissue culture, in recent years, has created unprecedented opportunities in floriculture, agriculture and horticulture, employment generation, and income generation through exports. Use of plant cell cultures for the production of secondary metabolites has a number of advantages over conventional procedures. It could ensure a continuous supply of uniform-quality, highly specialized natural components that cannot be produced in equal quality or specificity by other means of biotechnological procedures.



MCRC has been involved in plant tissue culture biotechnology and is following a two pronged strategy: one for mass multiplication of commercially important as well as endangered plants and the second for production of value-added secondary metabolites. Clonal propagation of medicinal plants is undertaken at MCRC. The plants chosen for the mass multiplication programmes are tea, rose, *Jatropha curcas*, and certain endangered medicinal plants like *Gymnema sylvestre*, *Stevia rebaudiana*, *Kaempferia galanca* and *Catharanthus roseus*.

V. BIOFUELS

Biohydrogen

Rapid depletion of fossil fuel and the ever increasing deficit of conventional energy have forced developing countries like India to concentrate more on alternate sources of energy for economic growth. Hydrogen has already received worldwide attention as the energy source of the future as it is clean, higher energy containing and environmentally benign. Hydrogen energy technology has been a part of our scientific study for over a decade. With financial assistance from the Ministry of Non Conventional Energy Sources (MNES),

MCRC has developed a biological process for generation of Hydrogen from a variety of sugar containing wastes from industries. Very efficient H₂ producing microbial systems comprising (a specific heterotrophic bacterium and a phototrophic bacterium) have been developed at this center using a novel co-culture technology. Using the distillery effluent of M/s. E.I.D. Parry Ltd., at Nellikuppam, Tamil Nadu, MCRC has succeeded in scaling up this technology to a 125 m³ bioreactor that could hold 1.00 lakh liters of effluent capable of producing 18,000 liters of total gas per hour in a continuous mode and under completely automated condition. The gas produced contains 65 to 70% of H₂ and the remainder is CO₂.

Utilization of effluents for hydrogen production also serves as an effluent treatment strategy as the BOD and COD get reduced considerably in the process. Work is in progress on methods to reduce the production cost, utilization of hydrogen (i) for power generation using fuel cells and (ii) for cooking purposes using specially designed burners. Research on automation of the production and a special burner to lit hydrogen, are ongoing.



Biogas production and Anaerobic processes

Anaerobic fermentation is a biological process, which takes place in the absence of air, resulting in production of methane, CO₂ and H₂O with, for example, cattle dung as substrate. In an effort to improve the design of anaerobic systems, MCRC has developed various reactors of 50L, 60L, 1000L and 3000L capacities for the production of biogas mainly from cow dung. Various parameters have been studied on the production of methane gas and the efficacy of residue as manure has also been studied. Presently MCRC is maintaining bacterial consortia for methane production suitable to hilly regions and plains.



Microbial production of alcohol

To replace the ever increasing demand of fossil fuels countries like Brazil have long ago shifted to ethanol as fuel for vehicles. A similar program of alternative sources of fuel for India is tried at various levels. Ethanol is a high octane, water free alcohol, produced from fermented sugars, starch, wheat straw, wood and waste paper by microorganisms. Lignocellulosic biomass can be utilized to produce ethanol, which is a promising alternative energy source for the limited crude oil. Lignocellulosic materials, containing cellulose, hemicellulose and lignin, are the most enormous renewable organic resources found on earth. The conversion of both cellulose (glucose) and hemicellulose (Hexose and pentose) for the production of fuel alcohol is now being studied intensively, with a view to develop a technology and an economically viable bioprocess.



Bio-petrol from algae

In the search for an alternative to fossil fuel, MCRC, one of the pioneers in algal biotechnology, is also focusing its attention on studies of hydrocarbon producing *Botryococcus braunii*.



Charcoal briquetting

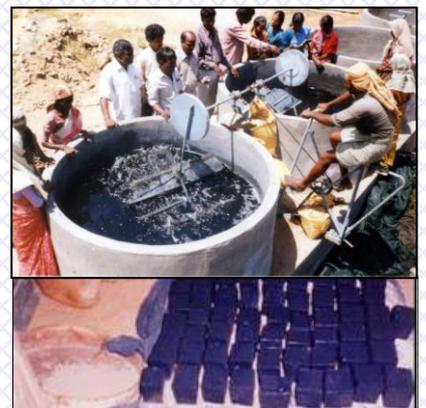
Charcoal briquette can prove to be a solution for curing the grim national maladies like energy and economic resources crunch and consequent socio-economic and employment problems. The biomass of different plants and their parts will have different combustion properties, which influence the quality of briquettes made. While the wood as a raw material serves as a best source for briquetting such an activity leads to deforestation and causes environmental problems. Hence other raw materials of the plants including leaf litter and other usufructs of the plants are tried at MCRC.



VI. NATURAL DYES

Plant dyes

The ever-increasing usage of chemicals in dyeing has been leading to leakage of effluents to surrounding soils and water column. To mitigate this problem MCRC has been conducting research on usage of natural dyes. We have a program where both higher plants and microbes are used as sources for natural dyes. In the case of higher plants we have developed a technology for efficient extraction of indigo from *Indigofera tinctoria*. A new method that involves microbial process has been found for efficient extraction of indigo dye. A patent has been filed.



Microbial dyes

In the area of microbial production of dyes, MCRC has initiated an ambitious program on the production of dyes from fungi and bacteria. Macrofungi belonging to Agaricales and Aphylophorales produce various colors. Production of pigments from *Ganoderma lucidum*, *Coriolus versicolor* and *Amanita muscaria* and microfungi as well like *Monascus ruber* have been studied. A short-period cultivation of *Ganoderma* sp. has been found and a patent is filed.



VII. ECOFRIENDLY PAPER PRODUCTION

Conventionally paper is produced from wood by mechanical and chemical pulping. However MCRC uses plant usufructs for paper production through microbial processes. Usage of fungi and bacteria for biopulping and biobleaching makes the entire process ecofriendly. The raw materials being tried at MCRC include agricultural wastes, bagasse, banana stems, matgrass, jute waste and hosiery wastes.



VIII. BIODIVERSITY & BIOPROSPECTING

MCRC has an expanding culture collection containing bacteria, fungi, cyanobacteria and microalgae. MCRC is currently working on a number of microbes producing bioactive compounds/specific metabolites of special interest.

Our strength has also been in the area of microbial diversity. The diversity of microbes (fungi and bacteria) from different environments including marine are being studied. Studies contemplated include diversity of litter fungi; soil fungi; marine fungi and bacteria in mangroves and other maritime environments in addition to terrestrial environments; diversity of methylotrophs in air, phylloplane and other environments. MCRC has recently carried out a bioresources project where in the higher secondary school children were imparted knowledge on the bioresources through lectures, field studies and audiovisuals.

RESEARCH ON ENGINEERING ASPECTS

HDPE Catamarans

HDPE (High Density Polyethylene) is a polymer, which has high buoyancy, and hence holds more load compared to wood. A new version of HDPE boat, which makes use of an outboard motor, has been used at the backwaters of Ennore on the Chennai East Coast. MCRC has successfully designed and built boats for artisanal fishermen in Orissa, India and the recently affected tsunami victims of TN coast.



Solar stills

Scarcity of drinking water is a major problem with increase in population. MCRC has developed different types of solar stills for converting brackish water into potable water. Apart from solar-based water distillation units designs for harvesting solar energy for cooking and power and steam generations had also been developed. Further research in these directions is in progress.



Other engineering devices include (1) Fish aggregating devices that looks like a garden to the marine organisms especially to the fish

population has also been designed at MCRC. The attracted fish aggregate around this device and catching them becomes easy; (2) **Hydraulic Ram Pump** (HRP) technology, adopted by MCRC, has a self-acting pump, which utilizes the natural kinetic energy of falling water to lift part of it to greater elevation. This technology is being applied for sustained water supply to tribal population in Karantamalai hills and Valparai hills through suitable engineering up-gradation; (3) **Steam-cured mud blocks** are produced with efficient use of fly ash and by standardizing the curing temperatures. Frequent training Programmes were conducted to NGO's, Entrepreneurs and local masons who are in the civil related areas; (4) **A cycle trailer** with mild steel plates was constructed at MCRC under the Council for Advancement of People's Action and Rural Technology's project. This has been disseminated by training to 72 village youth. The trailer can be easily attached to a cycle. The carrying capacity is 150-200 kg. Eight such trailers were made at MCRC and 24 at the training centres in four districts of Tamil Nadu.



COMMUNITY FRIENDLY INITIATES

Technology Resource Centre (TRC)

The Technology Resource Centre (TRC) formed at MCRC by CAPART, Government of India, has been active in disseminating technologies and programs intended to improve the living standards of the rural people. All the technologies, either conceived and developed at MCRC or adopted from other sources are tested thoroughly and found useful for our villages. Regular training programs, workshops and self-learning exercises meant for NGOs, small entrepreneurs, farmers, self-help groups and voluntary organizations serving in rural areas are conducted. The TRC also conducts many awareness programs and discussion meetings as well as social camps and awareness tours on environmental protection, pollution control measures, importance of vegetation, conservation of water and need for effluent treatment.

Academics

MCRC guides & provides infrastructure to M.Sc. students of different educational institutions to carry out short-term research projects in addition to the Ph.D. programs registered with University of Madras.

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