

## ABSTRACT

Jeevamrutha is a traditional organic bioformulation used for several decades by farmers. It is prepared using locally available resources such as cow dung, cow's urine, jaggery, pulse flour, soil, and water. Though jeevamrutha is said to possess various beneficial properties related to soil and plant health, till date detailed studies highlighting its microbial dynamics, functional properties and long-term field studies are lacking. To address several issues associated with jeevamrutha, the present study was carried out under five objectives to understand jeevamrutha preparation, structural and functional diversity of microbes and their role in promoting plant growth and soil fertility. Further, long-term field studies were conducted to understand the impact of jeevamrutha application on soil and plant health.

A field survey was conducted at several places in India, during which a questionnaire comprising 19 questions about jeevamrutha was used to document farmers' opinions/experiences related to its use. The survey's significant finding was that most farmers use jeevamrutha as it is low cost, prepared using local resources, and organic. However, due to the lack of scientific validation of jeevamrutha, young farmers showed apprehension regarding its future use. The survey was followed by physicochemical and microbial characterization of jeevamrutha in the laboratory. The pH, EC, TDS, DO, C/N ratio, protein, microbial load, and activity was assessed for 12 days of jeevamrutha incubation. It was found that, as the incubation progressed, a pH decline was observed along with an increase in EC value.

Further, the microbial characterization revealed that jeevamrutha is a fermentative product harboring various microbes dominated by *Lactobacillus spp.* During incubation, bacterial succession happens, facilitating the survival of only those microbes that can withstand the unique physico-chemical and biological conditions of jeevamrutha. Moreover, metagenomics, metabolomics, and proteomics analysis of eight-day old jeevamrutha revealed the presence of phylum Firmicutes, Bacteroidetes, and Proteobacteria as the dominant microbial communities. The presence of bacteriophages, fungi, and unclassified microbes in jeevamrutha indicated its diversity and potential for further research. Further, various metabolites such as lactic acid, ascorbic acid, caproic acid, succinic acid, etc. and proteins such as chaperone proteins, heat shock proteins, elongation factor-Tu, etc. were found in jeevamrutha. The diverse microbial communities and the metabolites and proteins present in jeevamrutha were reported to promote plant and soil health directly or indirectly.

Moreover, field experiments were conducted to understand the impact of long-term jeevamrutha application on soil parameters such as soil organic carbon (SOC), pH, microbial load, and water holding capacity. It was found that jeevamrutha application along with basal application of farmyard manure (FYM) for four consecutive years increased the SOC and microbial load, thereby improved the soil quality and fertility. Further, jeevamrutha application along with FYM was found to increase growth of medicinal plant *Centella asiatica* and enhanced the yield from the 102 to 120 kg/acre. Overall, the present study is an attempt to scientifically validate jeevamrutha and evaluate its impact on soil health upon long-term application.