

## Chapter 48

# Food Grade Microorganisms for Nutraceutical Production for Industrial Applications

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### **ABSTRACT**

*Nutraceuticals are the food ingredients which have a proven beneficial effect on human health. These include low calories sugars, proteins and vitamins B complex, etc. Microorganisms, such as Lactococcus lactis, are ideal microbial cell factories for the production of these nutraceuticals. Developments in the genetic engineering of food-grade microorganisms have been very helpful for enhanced production or overexpression of nutraceuticals. This chapter describes the use of food grade microorganisms in industrial production of nutraceuticals. The main emphasis is on industrial production of these beneficial nutraceuticals by food grade microorganism. The diversity of microbial cell types, various approaches for improved nutraceutical production through process optimization as well as strain improvement of the producing microorganisms are discussed.*

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## **INTRODUCTION**

The term ‘nutraceuticals’ coined by Stephen DeFelici in the 1980s is defined as ‘a wide range of foods and food constituents with a demanded medical or health benefit’. Thus, nutraceuticals include such substances that are food or portion of food delivering medical or health benefit, counting disease prevention as well as treatment. Recent decades have witnessed an increasing number of such food components and various nutraceuticals have been used in food and pharmaceutical products. Beneficial act of these nutraceuticals scale from the supply of essential vitamins and minerals, to prevention of several infectious diseases (DeFelice, 1995). Moreover, nutraceuticals enhance body’s defense against disease conditions, especially against aging that includes oxidative stress, depression, inflammation, arthritis, osteoporosis, cardiovascular disease and cancer (DeFelice, 1995; Pandey, Verma, & Saraf, 2010; Jain, & Ramawat, 2013). Recently, the perception towards nutraceutical has reformed as a product isolated or purified from foods that sells in the form of therapeutic agent and is generally not allied with food (Pandey, Verma, & Saraf, 2010). These are more precise to functionally diverse bioactive compounds that withstand long term medicinal or physiological benefits. These can be derived from microorganisms (e.g. amino acids, etc.), plants (e.g. phytochemicals, vitamins, etc.), or animals (e.g. polysaccharides, proteins and lipids) sources.

The escalating demands of nutraceuticals cannot be fully met by traditional nutraceutical industries. The availability and cost of raw materials are two most important factors that significantly limit direct extraction strategies. An alternative approach that could be utilized is chemical synthesis but this is limited to simple biochemical complexes. The growing demands of sustaining human health through diets have greatly enhanced the growth of nutraceuticals market. According to the recent report by global Information Inc., the global nutraceutical market was may exceed USD 241.10 billion by 2019 (Jain, & Ramawat, 2013).

To solve the problem of meeting the growing nutraceuticals demand, enhanced microbial production of these compounds seems to be an inevitable solution. A large number of microorganisms produce nutraceuticals naturally. Their genetic modification in combination with optimization of culture conditions for fermentation process can help in scaling-up of production of nutraceuticals to industrial level. Metabolic engineering of microbes for increased nutraceutical production is another interesting approach and has resulted in great developments with regards to production of value added nutraceuticals. This chapter deals with different aspects related to microbial fermentations for production of different types of nutraceuticals, including main upstream and downstream processes.

## **CLASSIFICATION OF NUTRACEUTICALS**

Nutraceuticals can be classified on the basis of their pharmacological conditions, natural sources, or according to their chemical constituents. Some of the most common ways of classifying nutraceuticals can be based on food sources, mechanism of action, chemical nature, etc. The food sources used as nutraceuticals are all natural and can be categorized as follows:



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