



“MODERN BIOTECHNOLOGY”- A TREMENDOUS APPLICATION OVER TODAY’ S DAIRY INDUSTRY

DR. D. PADMAVATHI

Guest Professor,
Dept. of Nutrition, FSM, & Dietetics
Muthurngam Government Arts College (A),
Vellore. (TN) INDIA

ABSTRACT

Biotechnological achievements of recent years have emerged as powerful tool to develop quality attributes of livestock products include dairy and dairy-based products. Biotechnology has applied to food processing in most developing countries makes use of microbial inoculants to enhance properties such as the taste, aroma, shelf-life, consistency, and nutritional value of foods/dairy products. Probiotic food products are a rapidly growing area of functional food, as found to be robustly accepted by the consumers. However, the food industry is looking for to produce diverse varieties of probiotic foods other than dairy products with prospective health benefits. In this review, the broad array of available dairy foods, by-product waste utilization of dairy and dairy processing challenges the microbiologist, engineer and technologist to find the best ways to prevent the entry of microorganisms, destroy those that do get in along with their enzymes and prevent the growth and activities of those that escape processing treatments. Various food matrices, dairy, and non-dairy, have been used with probiotics, by-product wastes utilization and were briefly acknowledged.

Keywords: *Biotechnology, Dairy processing, Dairy products, Food biotechnology, Food processing*

INTRODUCTION

Staple food constitutes the most indispensable and basic need of man for fulfilling minimal nutritional requirements to sustain human life on earth. Man has been traditionally depending upon agriculture and livestock to meet food demands since times immemorial. It is obligatory on the part of all Governments to provide safe, wholesome and nutritious foods to their citizens belonging to all the sections of society.

A healthy diet can play a significant role in creating a healthy mind and healthy society in the country. Adequately nourished and healthy citizens can serve as the work force in building a

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Nation by boosting the growth, prosperity and productivity. However, the overall quality and safety of food commodities can be considerably influenced by the food processing and packaging to provide optimal nutritive value to the consumers. With the advent of new scientific knowledge and technological innovations, food sector is witnessing a phenomenal growth across the world particularly in developed countries. Although, developing countries like India are the potential markets for variety of such processed foods, their indigenous food processing industry is still in the transition stage to adopt modern and advanced food processing tools to compete with the developed countries. One such powerful technique that can be very promising and highly relevant to food processing industry in countries like India is the Biotechnology. By judiciously applying biotechnological tools and processes, the quality, safety and nutritive value of processed foods can be improved considerably with lot of value addition.

ROLE OF BIOTECHNOLOGY IN FOOD SECTOR APPLICATIONS OF FOOD BIOTECHNOLOGY

The high value-added products are progressively more created in more scientifically highly developed budding countries for use in their food and non-food processing application. Many of these high value-added products are also imported by budding countries for use in their food processing applications. The applications of biotechnology method in the food and agricultural manufacturing are one of the many aspects of biotechnology that has great force on society. By the year 2050, it is likely that more than 10 billion people will be living on this planet, and it is also whispered that there may not be sufficient property to feed the world population. Biotechnology has a main application in the food

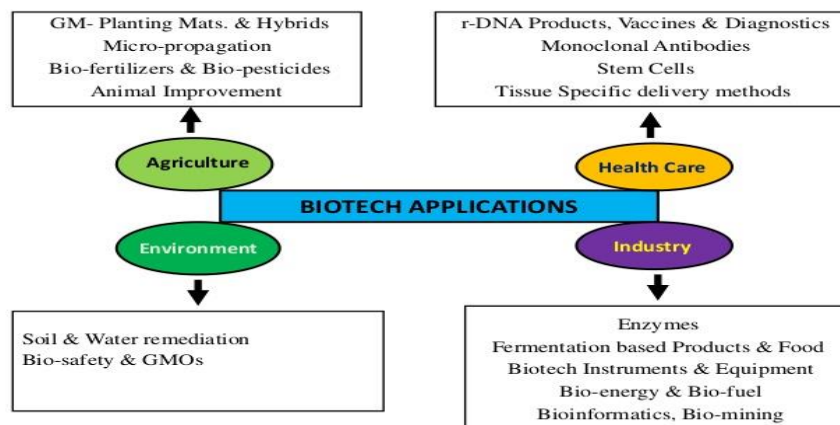
Biotechnology has already benefitted the food industry in a big way. It has given us high quality foods that are tasty, nutritious, wholesome, convenient, shelf stable and safe. As research and development initiatives continue, it seems inevitable that biotechnology will have an increasing impact on the food we eat. It offers huge potential for increasing the range and quality of food available to us, particularly more nutritious and palatable foods. It also seems likely that it will continue to bring advantages to the processing and safety monitoring of food supply due to emergence of new technologies at a faster pace.

Traditional biotechnology that makes use of natural microbial fermentations has been playing a vital role in the development of our food supplies such as cheese and yoghurt-making and the use of yeast to leaven bread and ferment alcohol. For thousands of years, the second-generation food biotechnology is based on initiatives to screen enzymes and micro-organisms in the natural environment and exploit them for useful applications such as food ingredients, microbial fermentation to manufacture several products like lactic acid, citric acid and other

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flavor enhancers etc. However, the major focus is now on exploring the modern biotechnology which is based on a combination of molecular genetics, applied enzymology and fermentation technology for value addition to foods. It is the modern Biotechnology which is becoming increasingly important part of the overall efforts to improve methods of food production and to increase the variety, quality and safety of foods we eat.



Potential Areas for Biotechnological Applications

There are several potential areas in the food industry where the traditional and modern biotechnological tools can be applied during processing for the overall improvement of the nutritional quality, safety and health promoting attributes of the processed foods specifically with regard to the dairy based fermented products. Some of the potential areas of considerable commercial interest in food industry that can be targeted for biotechnological interventions are listed below:

1. Food fermentations
2. Starter cultures technology and genetic manipulation
3. Recombinant Enzymes
4. Bio preservation of foods
5. Functional / Health foods and Nutraceuticals
6. Probiotics, prebiotics and symbiotic foods
7. Genetically modified foods (GMFoods)
8. Milk derived bioactive peptides and other functional ingredients
9. Low calorie foods
10. Food packaging
11. Diagnostic tests for food safety and quality assurance
12. Biosensors

FOOD BIOTECHNOLOGY IN MILK AND MILK BASED PRODUCTS

DAIRY INDUSTRY

Dairy products are recognized as healthy natural products. Biotechnology can play an incredibly effective and force full role in enhancing the food and nutritional security in the country. Modern developments in the biotechnology have opened up new and stimulating possibilities in dairying for enabling the accessibility of milk and milk products within the attain of poor and cater to the needs of large sections of the population. Dairy industry, in particular, can enormously promote through biotechnological interventions which can not only develop the overall quality and safety of processed dairy foods but also improve their commercial values for local consumptions and exports. Since, the major obligation of dairy industry is to offer high quality nutritious, healthful and inexpensive dairy foods to the consumers; it has become predictable to incorporate biotechnological intervention at a different stage of milk production and processing.



Milk is a white liquid biological secretion from the mammary glands of female mammals. Conventionally, milk has been considering the most entire food providing by nature. It is a vital resource of necessary nutrient required for the growth and growth of newborn. It is also extremely suggested in the diet of adult humans due to its high dietary assessment. It is, generally, composed of water, proteins, lipids, carbohydrates, vitamins, and minerals.

Lactose is the main carbohydrate found in milk. It has been reported that lactose can stimulate the combination of minerals together with calcium and magnesium. Diglycerides, monoglycerides, esters, and cholesterol are initiate at low levels. The purpose of the lipid materials in milk is to transport the fat-soluble Vitamins A, D, and E. Furthermore, it has been established that milk not only contains nutritive compound but also in nature active ones, like caseins and whey proteins. It is the major resource of nourishment for young mammals before they are able to digest another type of food. Early lactation milk contains

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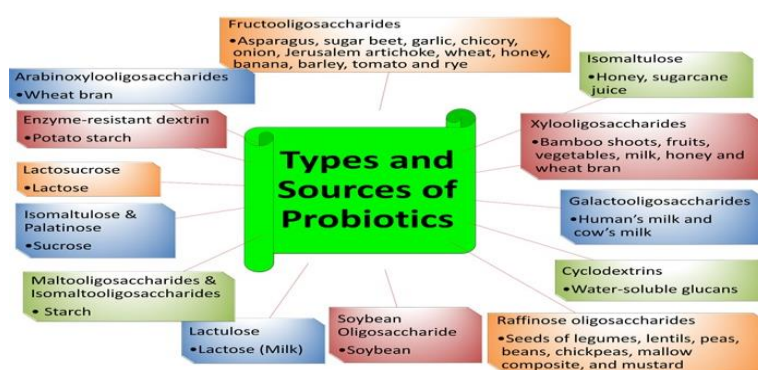
colostrum, which carries the mother’s antibodies to its young and can decrease the hazard of many diseases

The World Health Organization (WHO) recommend limited breastfeeding for 6 months and in addition to other food for at least 2 years. In a few cultures, it is familiar to breastfeed children for 3–5 years and the period may be longer. Conventionally, milk has been considering the most entire food provided by the nature. It is also tremendously suggested diet of adult humans due to its high dietary value. Fresh goat’s milk is occasionally substitute for breast milk. This introduces the risk of the child embryonic electrolyte imbalance, metabolic acidosis and a host of allergic reaction.

Since of its high dietary content, milk can be used to manufacture a large array of dairy foodstuffs such as whole, skim, lactose-free, and skimmed milk powder. Milk is also used to make the fermented dairy products cheese, yogurt, kefir, Butter, milk whey, lactic or renin, caseinates, lactose, enzymatically modified milk ingredients, ice cream, and other dairy beverages are the major commodities we attain from milk.

PROBIOTICS

Probiotic is a fairly new word meaning “for life,” which is used to name microorganisms that are linked with the advantageous effect for humans and animals. The probiotic microorganisms consist mainly of the strains of the genera Lactobacillus and Bifidobacterium, but strains of Bacillus, Pedi coccus, and some yeast have also been established as appropriate candidates.



LATENT APPLICATIONS OF BIOTECHNOLOGY IN DAIRY SECTOR

Biotechnology has previously made significant offerings in dairy industry. Some of the possible applications and future scenario are given below:



Dairy Production

- Recombinant bovine.
- Recombinant vaccines.

DNA fingerprinting

- Embryo transmit technology.
- Animal cloning.
- Gene forming and transgenic.

Dairy Processing

- Food grade bio-preservatives.
- Dairy enzymes/proteins.
- Probiotics.
- Functional foods and nutraceuticals.
- Dairy waste organization and pollution control.

ROLE OF ENZYME ACTIVITY

RENNET

Milk contains proteins, especially caseins that uphold its liquid form proteases are enzymes that are added to milk throughout the cheese manufacture, to hydrolyze caseins, which stabilize micelle arrangement, prevent coagulation. The most familiar enzyme extracted from rennet is chymosin.

CHYMOSIN

Chymosin can also obtain from numerous other animals, microbial, or vegetable sources, but indigenous microbial chymosin is unsuccessful for making cheddar, and other hard cheeses Bio-engineered chymosin may be concerned in the manufacture of up to 70% of cheese products. Milk contains number of diverse type of proteins, in addition to the caseins. The denaturing of whey proteins such as lactalbumin and lactoglobulin using proteases result in the creamier yogurt product.

LACTASE

Lactase is a glycoside hydrolyzes enzyme that cut lactose into its essential sugars, galactose, and glucose. Lactase is used commercially to organize lactose-free products, mainly milk, for such individuals it is also used in the preparation of ice cream, to make creamier and sweeter tasting manufactured goods. Lactase is as frequently organized from Kluyveromyces sp. of yeast and Aspergillus sp. of fungi.

CATALASE

The enzyme catalase has established partial use in one exacting area of cheese manufacture. Catalase enzymes are characteristically obtained from bovine livers and are further to transfer the hydrogen peroxide to water and molecular oxygen.

LIPASES

Lipases are used to break down milk fats and give attribute flavours to cheeses. The flavor comes from the free fatty acid created when milk fats are hydrolysed. Hydrolysis of the shorter fats is preferred, since it results in the popular taste of many cheeses and the longer chain fatty acids can affect in also soapiness or no flavor at all.

ENZYME	USE
Protease	used to pre-digest proteins during the manufacture of baby foods
Lipase	used - together with protease - in biological detergents to break down - digest - the substances in stains into smaller, water soluble substances
Carbohydrase	used to convert starch syrup, which is relatively cheap, into sugar syrup, which is more valuable - for example, as an ingredient in sports drinks
Isomerase	used to convert glucose syrup into fructose syrup - fructose is sweeter than glucose, so it can be used in smaller amounts in slimming foods

NUTRITION AND FOOD SAFETY

Fermentation processes enhance the nutritional value of foods through the biosynthesis of vitamins, essential amino acids and proteins, through improving protein and fibre digestibility; enhancing micronutrient bioavailability and degrading antinutritional factors. Many bacteria in fermented foods also exhibit functional properties (probiotics). The safety of fermented food products is enhanced through reduction of toxic compounds, such as mycotoxins and cyanogenic glucosides, and production of antimicrobial factors, such as



bacteriocins, carbon dioxide, hydrogen peroxide and ethanol, which facilitate inhibition or elimination of food-borne pathogens.

Intellectual property rights (IPRs)

The processes used in the more advanced areas of agricultural biotechnology tend to be covered by IPRs and these rights tend to be owned by parties in developed countries. This applies also to biotechnology processes used in food processing. On the other hand, many of the traditional fermentation processes applied in developing countries are based on traditional knowledge. In addition to biotechnology processes, microbial strains may also be the object of IPRs.

COMMERCIAL OPPORTUNITIES

Biotechnological innovations have greatly assisted in industrializing production of certain indigenous fermented foods. Indonesian Tempe and Oriental soy sauce are well known examples of indigenous fermented foods that have been industrialized and marketed globally. The results of biotechnology research will lead to fermented foods of improved quality, safety and consistency.

CONCLUSION

Biotechnology undoubtedly has a potential role in food processing industry in India and other developing countries and hence can help in meeting the food and nutritional security effectively. Judicious use of modern biotechnology tools and strategies could be extremely valuable not only to increase the food production for the growing population but also can aid in improving the processing quality, taste, nutritional value, texture, shelf life, marketability and added advantages of having medicinal properties for various ailments, thereby, enhancing the commercial value of these foods considerably. The resurgence of concept of functional foods and nutraceuticals for health applications gained momentum at the global level through biotechnological applications. These value-added biotech-based farm products tailored to processing industries certainly can increase farmers and processors revenue, at the same time satisfying the consumer preferences. Biotechnology has tremendous potential for increasing food production and improving food processing although the real impact will only be felt after a few decades and it will differ from country to country.

Nevertheless, biotechnology can have a dramatic impact on the food processing industry in developing countries like India by not only improving the efficiency of food processing but also through value addition and product diversification for catering to the needs of both

domestic market and their exports. Additionally, biotechnology interventions in the food chain of agriculture and food processing sectors can generate lot of employment opportunities in the country. By producing safe, high quality, nutritious wholesome and healthy foods within reach of common consumers, biotechnology can help in creating a healthy society and can tremendously boost the growth, productivity and economic status of India at the global level.

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