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Mini Review

Biotechnology in Food Production and Processing

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Abstract

Biotechnology is an interdisciplinary feild of Research. There are various areas of Biotechnology Research such as Industrial Biotechnology, Marine Biotechnology and Food Biotechnology.

Keywords: Biotechnology; Dairy Products; Beverage

Introduction

Biotechnology is an interdisciplinary field in science which includes combination of biology and engineering and technology to develop products that are sustainable for human health as well as environment. The application of biotechnology has been increasing day by day in various fields which includes medicine and healthcare, agricultural and crop production, biofuel manufacturing and food production and quality control.

The field of Food Biotechnology had provided us with various kinds of microorganisms and enzymes which are biologically important for the production of several kinds of food and beverage products such as bread, fermented dairy products (curd, cheese, etc.) and beverage products (tea, coffee, alcoholic drinks, etc.).

In this Chapter we will be mainly focusing on the biotechnological aspects of Food production and processing which will enable us to understand and enhance the knowledge of Biotechnology in the field of Food science and engineering [1-10].

Characterization of Biotechnology according to various fields

The field of Biotechnology can mainly be characterized into ten types according to their colour codes and the areas of activity [Table 1]. The field includes the advancement in the field of Food production, Crop improvement, Bioinformatics, Nanotechnology, etc.

Table 1: Colour codes and their Areas of activity in the field of Biotechnology.

Colour codes	Areas of activity
Red	Heath and Medicine
Yellow	Food and Nutrition
Blue	Aquaculture and Marine science
Green	Agriculture, Environment and Biofuel
Brown	Arid zone And Desert
Dark	Bioterrorism
Purple	Patents and IPR
White	Gene-Based Bioindustries
Gold	Bioinformatics and Nano-Technology
Grey	Bioprocess and Fermentation Technology

Applications of biotechnology in food production and processing

The Applications of Biotechnology in Food processing and production are as follows:

- Disease-Free and Pest resistant Plants.
- Agriculture on Acidic Soil.
- Fortification of Crops.
- Edible Vaccines.
- Enzyme usage for fermented food production.
- Increasing Shell life and Production of Taste Enhancer.

The Application of Biotechnology in the field of Food Production and processing has harnessed the true potential of the interdisciplinary subject [11].

Disease-free and pest resistant plants

Biotechnology has proved to provide a very efficient technique in producing Disease-Free and Pest resistant Plants. Micro-propagation is one the most efficient technique used for the production of Disease-Free Plant. Bannas are the type of plants which mainly associated with the production through micro-propagation technique. Micro-propagation is the technique of culturing plant tissue in desired controlled environment and mainly applicable for culturing of monocot plants. Bt crops are the type of genetically modified (GM) plants which are made resistant to certain pest and insect. To produce such kind of plants the Bt gene which is responsible for producing Cry protein a kind of toxin is incorporated in the plant genome. The most common type of crop produced through this technique is Bt brinjal, mainly cultivated in the European and American subcontinent [12,13] [Figure 1].

Figure 1: Plant tissue culture in controlled environment through micropropagation.

Agriculture on acidic soil

The selection of acidic soil resistant plants can be done through a very simple yet very effective method through selection in stress condition or incorporating genetic-markers in the plant genome. But the selection method is considered as the most cost effective and simple. Here the plants are grown in a low pH or acidic condition for natural selection of the tolerant plant, which is further sent for genetic modification and callus culture for mass production [14].

Fortification of crops

Fortified crops emerge as a good food source for rising malnourished youngsters in poor countries or countries where food is in short supply. One example of such fortified crops is 'Protato'. This genetically engineered potato is commonly grown and utilised in India, and it contains around one-third to one-half more protein than a regular potato. In addition, this genetically modified potato contains significant amounts of all necessary amino acids, including lysine and methionine. This 'Protato' could be a very promising food source in places where potatoes are a major staple meal.

Golden rice is another example of this type of crop. The genetically engineered rice has a greater beta-carotene concentration. Cowpea grains and leaves are traditionally served as a side dish or condiment. Cowpeas are consumed as a staple cuisine in many nations. Genetically modified cowpeas have been grown in Tanzania [15-17].

Edible vaccine

Edible vaccines are subunit vaccines that insert specified genes into plants and stimulate the transgenic plant to produce the encoded protein. Foods that fall under this category include potatoes, bananas, lettuce, corn, soybeans, rice, and legumes. They are simple to administer, store, and provide a suitable delivery system for patients of all ages while being cost effective. Edible vaccinations offer great possibilities for drastically decreasing diseases such as measles, hepatitis B, cholera, and diarrhoea, particularly in developing countries. However, several technical and regulatory difficulties must be overcome in order for edible vaccination technology to become more efficient and relevant [18] [Figure 2].

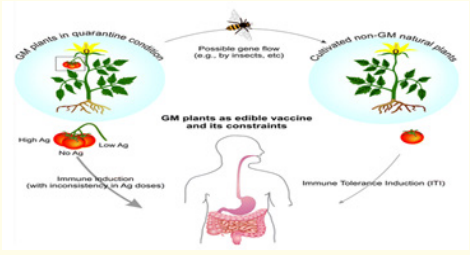

Figure 2: The Process of producing edible vaccine. Barzegari, 2014. Copyright 2014 by Abolfazl Barzegari.

Enzyme usage for fermented food production

Enzymes are specifically used in the processing and manufacture of various food items on an industrial scale. Companies began employing enzymes to digest food in the twentieth century's second decade. Food is produced by creating techniques for genetically modifying organisms. These enzymes include sugars and proteases. Cloning these genes in a short period of time could result in maximum production. These enzymes are specifically utilised in the production of curd, cheese, and food flavouring. The food business uses the highest percentage of enzymes. More than half of all carbohydrates and proteases are used in the food sector in the United States. These enzymes consist of α-amylase and rennin [19] [Figure 3].

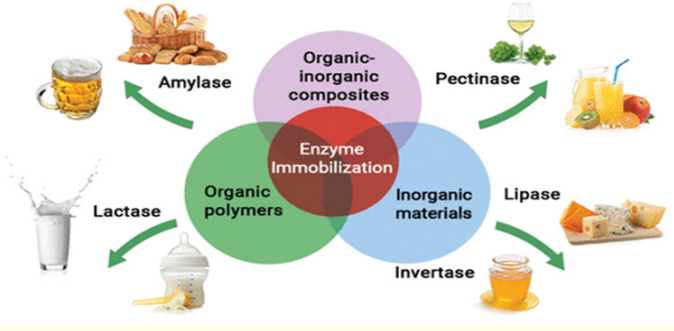

Figure 3: Enzyme usage in food production. Yushkova, 2019. Copyright 2019 by Ekaterina D. Yushkova.

Increasing shell life and production of taste enhancer

Various fruit juices have a short shelf life. For example, tomatoes are consumed all around the world. Tomatoes should be gathered at the mature green stage in order to transport. They are exposed to ethylene to accelerate ripening and then picked. Tomatoes ripen quickly due to higher temperatures, yet their flavour may be ruined at lower temperatures. Cal gene, a California-based business, produced genetically modified tomatoes to remedy the problem. They created the Flavr-Savr tomato variety to address the issue. Polygalacturonase is an enzyme that breaks down pectin to ensure that it ripens properly. Scientists genetically engineered tomatoes to reduce the amount of enzyme. Antisense RNA is utilised for this specific reason. In stronger tomatoes, a low level of the enzyme results in cell wall and pectin disintegration. These Flavr-Savr tomatoes are firmer, have a longer shell life, and can be transported more easily.

GM foods with increased taste include eggplant, cherry, pepper, seedless watermelon and tomatoes, among others. The seeds are removed from these fruits, resulting in superior results such as increased sugar content in soluble form and increased sweetness in the fruits. Biotechnology is used to change fermentation pathways in order to enhance the flavour and aroma of wine [20-22].

Conclusion

Biotechnology's practical uses have converged to produce sustainable food in an efficient and safe manner. More study is needed in this subject to develop better and safer production and processing methods and procedures.

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