

Bioproducts from White Biotechnology – A Review

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Abstract

White biotechnology refers to the utilization of microorganisms or biomasses for the production of value added products from renewable sources. This technology provides useful and valuable products in numerous sectors and industries such as the food, pharmaceutical, agricultural sectors and lots more. Biotechnology is the manipulation of living organisms or their components for the production of products that are of useful importance to life. The vast metabolic diversities of microorganisms especially fungi, yeast, and bacteria can be utilized to produce various useful industrial products. There is a wide range of applications of biotechnology, and the uses of colours have been developed to differentiate the main areas of applications of biotechnology. The description *white* is used to differentiate industrial biotechnology, *green* is used to signify agricultural biotechnology, *blue* is used for marine and fresh-water biotechnology, *red* is designated for use in medicine and in pharmaceuticals, *purple* is used for patents and inventions and recently, *yellow* is used for insect biotechnology. This paper reviews the production of various bio products using white biotechnology.

Keywords: White biotechnology, Microorganisms, Biotechnology, Industry, Colours

Introduction

Biotechnology refers to a technology that is based on biology. It utilizes biological or chemical principles or both for the production of biological products to enhance and improve life. Biotechnology also involves the utilization of living organisms, plants or their components, for the benefit of the society, the environment and industries [1,2]. Numerous applications of biotechnology are abound. As a result of the wide range of applications of biotechnology, a means of differentiating or characterizing these applications has long been developed using colours [1]. These characterization includes; White biotechnology (used to differentiate industrial biotechnological process), green biotechnology (for agricultural biotechnology), blue biotechnology (for marine and fresh-water biotechnological application), red biotechnology (used in medicine and in pharmaceuticals), brown biotechnology (used for desert biotechnology), purple biotechnology (used for patents and inventions) and recently, insect biotechnology which has been coded yellow as it is an emerging area of entomology that utilizes insects in drug discovery [2].

Biotechnology has numerous applications in the field of pharmacy, medicine, agriculture and food production, industries and many more [3].

White biotechnology refers to, biotechnology that is applied for industrial processes [4,5]. It focuses on the production and processing of chemicals, materials and energy using living cells, such as yeast, fungi, bacteria, plants and enzymes to synthesize products that are easily degradable require less energy and create less waste during their production [6]. In addition, white biotechnology focuses mainly on energy production from biomasses and the improvement of variety of products that can be produced [7]. It also seeks to reduce the environmental impact of producing products from the utilization of fossil fuel. The utilization of white biotechnology is reported to reduce carbon dioxide emissions by a large percentage [8]. This review therefore provides a brief overview on white biotechnology and the useful bio products that are produced from its applications.

Bioproducts Derived from the Use of White Biotechnology

Many useful and beneficial biological products can be produced from the utilization of white biotechnology. These bioproducts include, Bioflavours (oligosaccharides, food additives and colorants), Microbial pigments, Microbial vitamins, Microbial amino acids and many more [8,9].

Bioflavors (oligosaccharides, food additives and colourants)

Bioflavours, colourants and oligosaccharides can be produced from biomasses via the utilization of agricultural residues as substrates [10,11]. White biotechnology is very useful in the production of bioflavours, as some of these bioflavours are either primary or secondary metabolites produced by microorganisms. Organic acids, particularly citric acid, lactic acid and acetic acid as well as the sweeteners, such as xylitol, sorbitol and aspartame are important classes of bioflavours reported to be produced using white biotechnology [12].

Microbial Pigments

Microbial pigments can be produced using white biotechnology [13]. The toxicity of synthetic pigments has led to research on microbial pigment and colours using white biotechnology [14]. Microorganisms such as bacteria are well known to produce bacterial pigments. These bacteria pigments are useful in fabrics dyeing, food colouring, indicators of oil leak index, biosensors and indicators of soil, water and air pollution, cosmetics and therapeutics [15]. Similarly, filamentous fungi have been reported to produce wide range of fungi pigments such as flavins, quinones, carotenoids, melanins, phenazines, azaphilones, anthraquinones, indigo and violet [16].

Microbial Vitamins

Microbial vitamins have been reported to be produced by some microorganisms during fermentation and regular metabolism of these microorganisms [17]. Most of these microbial vitamins are either primary or secondary metabolites of fermentation produced by microorganisms. Vitamins are micronutrients essential for the body's natural physiological function. They are predominately produced from external sources and are not made in the body of mammals. Some water soluble vitamins (such as, Ascorbic acid, Biotin, Riboflavin and Vitamin B12) and some fat soluble vitamins have been reported to be produced using white biotechnology [17]. Riboflavin (Vitamin B2) is reported to be produced by two *Ascomycetes*, *Eremothecium ashbyii* and *Ashbya* [5].

Microbial Amino Acids

Microorganisms are known to produce amino acids. These microorganisms have been reported to produce amino acids on a large scale [18]. *Corynebacterium glutamicum* and *Escherichia coli* are predominant producers of amino acids (such as L-tryptophan, L-methionine, L-lysine, L-phenylalanine, e.t.c.) [19]. Microbial amino acids and vitamins are major bioproducts of white biotechnology, as a large number of microorganisms are known to produce at least one amino acid during their various metabolic

functions [20]. Amino acids are building blocks for protein synthesis in living things.

Barriers and Challenges of White Biotechnology

The design and operations of biological processes, especially where microbial biomasses are utilized is very challenging when compared to the use of chemical processes [21]. However, the complexity of biological processes and reactions enhances a better environment and ecosystem as well as improves product availability and new designs [22]. One of the major challenge in biological processes is the need of scaling up production or unit increase [23,24].

Conclusion

White biotechnology is an important area of biotechnology that is focused on reducing the environmental impact of chemical or synthetic reaction processes while carrying out various industrial processes. This has encouraged the rapid evolution of numerous bioproducts and processes that have commercial and economic interests. White biotechnology involves the production of bioproducts of industrial interests, such as, amino acids, vitamins, flavours, sweeteners, colourants among others, using microbial biomasses with high yields and mild process conditions.

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