

# Research paper example

[Science](#), [Chemistry](#)



Biopolymers and their application Biopolymers are the polymer materials that can be obtained from renewable sources. The term ' biodegradable' is often applied to such materials. The main difference is that biodegradable material is destroyed in the natural condition due to the action of microorganisms, sunlight, temperature, moisture and oxygen. Most of the biopolymers (but not all) and some polymers obtained from the fossil fuels are biodegradable. Some biopolymers and most of polymers from fossil fuels are not biodegradable (Babu, OConnor, and Seeram 1).

Growing concern about environmental issues and the fact, that petroleum is a finite resource, increase attention to these materials. Twenty years ago synthesis of biopolymers cost more than synthesis of polymers from petroleum. However, rising prices made this sphere more attractive. Besides, biopolymers may not only substitute traditional polymers but also possess new characteristics (biodegradability, extreme strength, possibility to obtain thin and firm films) (Sample).

There are three way of to synthesize biopolymers. The first way is an extraction and modification of natural polymers from plants. The examples of such materials are thermoplastic starch, derivatives of cellulose and rubber. Rubber obtained from the rubber tree *Hevea braziliensis* is the first known polymer. The second pathway is a polymerization of bio-monomers. Polylactic acid (PLA), polyamides, polyurethanes and polyesters can be obtained using this approach. The third pathway is an extraction of polymers produced by microorganisms. Polyhydroxyalcanoates (so-called PHA family) can be obtained using this approach (Rudin and Choi 528). Microorganisms can also produce monomers or raw materials that can be extracted and

polymerized. For example, bioethanol can be produced from the sugarcane starch, wheat or corn through microbial strain and biological fermentation process. Afterward, ethanol is dehydrated over a solid catalyst to ethylene, which is polymerized to polyethylene (Babu, OConnor, and Seeram 6).

The production of biopolymers uses the well-known polymerization techniques. For example, polyamides or polyurethanes can be produced using free radical, cationic, olefin metathesis and condensation polymerization. Polylactic acid is obtained from lactic acid by the combination of condensation polymerization and ring opening polymerization or by one of the mentioned techniques separately. Polymers like PHA are synthesized by microorganisms (sometimes genetically modified) and extracted using centrifugation and press filtration. Biopolymer can be mixed with another biopolymer, a biodegradable synthetic polymer, or non-degradable synthetic polymer. It permits to change undesirable properties of biopolymer (thermal stability, strength) or to create a new biopolymer.

Additives like pigments, antioxidants, antiseptics and various inorganic fillers may be added to improve desirable properties of biopolymer (Rudin and Choi 529-531).

Biopolymers find their application in food industry, medicine, agriculture, fishery and environmental protection. Package from biopolymers is biodegradable and, thus, can substitute traditional polyethylene package. In medicine, biopolymers are used for the controlled drug delivery, wound healing, as dental impressions, bone replacement or fixation implants, and bone cements. Biopolymers are widely used in the food industry as low-calorie food additives providing bulk and texture or protective films for food

preservation (Babu, OConnor, and Seeram 2-12).

It is expected that the number of new synthesized biopolymers and their amount will grow. In their article, Babu, OConnor, and Seeram indicated, “ thanks to advancements in white biotechnology, the production of bio-based polymers and other chemicals from renewable resources has become a reality.” (12). the first generation of biopolymers was synthesized from food sources. The debates food-versus-fuel turned attention of scientists to utilization of other renewable sources (like wood and cellulose products) and to microbial synthesis. New materials from the renewable sources should become cost-effective, environmentally friendly alternatives to conventional polymers. This goal has to be achieved in further researches.

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