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Economic and environmental side of the use of biotechnologies Case Study: Synthesis of some bioplastics from algae

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Abstract

Disposal of plastic waste is a serious problem, because plastics accumulate in the envi¬ronment and cause significant pollution due to their degradability.
Therefore, the main objective of this research was to reach the biodegradable plastics industry as alternatives to non-biodegradable plastics. And the existence of such biode¬gradable plastic must contribute in reducing the emission of harmful greenhouse gases and keeps the environment clean, and reduces the cost for pollution from the accumulation of plastic waste.
Algae was used as a raw material for the production of bio-plastics because of its unique properties such as it grows rapidly and in large quantities at a low cost and grows in a variety of water environments throughout the year, which means that there is no risk in the difficulty of securing the raw materials needed for the production of bio-plastics
The study concluded that the tested samples partially decomposed in fresh and alkaline water during a period of 26 days, which means a high dependence on algae to the produc¬tion of bio plastics as an environmentally friendly industry.

Key words

Biotechnologies, Environmental Economics, Bioplastic, Algae.

JEL Classification: Q01, Q5, 013

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Introduction

Talking about the economic dimension of biotechnologies, it should be noted that any discovery itself may not have a direct and rapid economic impact; but when its practical applications are commercialized, it has a clear impact.

Biotechnologies have gone through several economic phases, they have been the fastest in the field of drug production, which has a clear economic impact, and as soon as the researcher gets a patent he can get a company to market this product.

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These biotechnologies have had a significant impact on the US economy since 2000, with 437,400 employees employed, 150,800 of which were created directly bybiotechnology companies, while the remaining 286,600 jobs were supported by materialand service supported companies, and the net additional revenue was $ 47 billion (Kapiel,2016).

Biotechnology industries can be linked to the achievement of the Sustainable Development Goals, which seek to reduce poverty and hunger, because there are goals and objectives that require the work of the entire community: To achieve the goal of ensuring environmental sustainability (Swaminathan, 2010). Such as producing bio plastic of Algae to prevent the damage caused by plastic waste (Anbuchezhian et a., 2015). also addressing water scarcity by recycling and treating wastewater before being reused in agriculture in developing countries (Swaminathan, 2010).

Plastic waste is one of the most prominent environmental problems in the world as it takes thousands of years to degrade naturally, if it decomposes completely, it contributes to the pollution of the environment elements of soil, water and air, and distort the landscape and the loss of soil fertility and susceptibility to agricultural investment (Wang & Nomura, 2010)

Industrial plastics consume fossil resources, in addition to the high economic cost associated with changing world oil prices, as well as the release of large quantities of harmful greenhouse gases during production and combustion (Shamsuddin et al., 2017).

Due to the wide and large use of this material and its rapid transfer to the environmental media causing serious damage, therefore, in this research has been produced biodegradable plastics from algae to replace petroleum-based industrial plastics because of its safe uses of the environment in general and living organisms in particular (Rajendran et al., 2012).

Algae are classified into three types: brown - green - red. Red algae are the most important species used in the production of bio-plastics due to their high protein content (50-70%) of their original content (Ali, 2010). In this study, red algae of "Jania Rubens" were selected in the marine research area in Lattakia because of their spread and the effect of the physiological and chemical composition of these algae on the synthesis of bio plastics. And the biodegradable properties of this algal bio plastics were also studied.

1 Materials and Methods

1.1 Sample Preparation

The algae were thoroughly washed with tap water and then dried in the oven at 60 ° C until the weight is constant, then ground and stored away from moisture.

1.2 Agar extraction

Agar (polysulfur polysaccharides) is a gel extracted from some red algae (Rhodophyta), consisting of long chains of agarose and agar pectin. The physical and chemical properties of agar are affected by the extraction method, while the temperature and time of extraction and alkaline treatment affect the yield and quality of the agar.

Native agar

16 g of dry algae were applied in a unit containing 800 ml distilled water at 100 °C for 4 hours. The extracts were filtered using a cotton cloth with holes diameters 10 urn. The filtrates were at room temperature and then placed in the freezer until the next day. The water was removed from the frozen extract using freezing-Thawing Method (Armisen & Galatas, 2000), until agar powder was obtained.

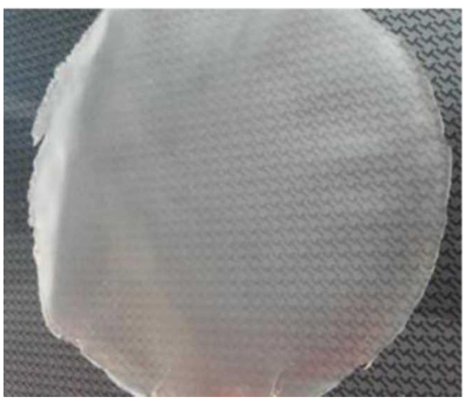
Alkali-modified agar

16 g of dry algae were applied in a unit containing 800 ml alkaline solution (NaOH 5%) at 100 °C for 1 hour. The alkali-treated sample was then washed with tap water and placed in 800 mL of distilled water and the mixture was adjusted to pH 6.4-6.8 using hydrochloric acid (Hcl). The extraction was then carried out at 120 °C for 2 hours (Chirapart et al., 1995).

1.3 Preparation of bioplastics films

First, 6.8 g of corn starch is placed in 240 ml distilled water in a 90 °C water bath with constant stirring. Then add 1.2 g of agar powder and 2 g of glycerin to homogenized starch solution with stirring for 5 minutes. The solution is poured into petri dishes and allowed to dry at 50 °C until the next day (Wu et al., 2009).

Figure 1 Physical appearance of bioplastic film



2 Results and Discussion

2.1 Extraction yield

Extraction yields vary depending on the type of moss and its life cycle, growth season, environmental conditions and extraction methods (Abbas, 2010).

Table 1 properties of agar produced by natural and alkali extraction

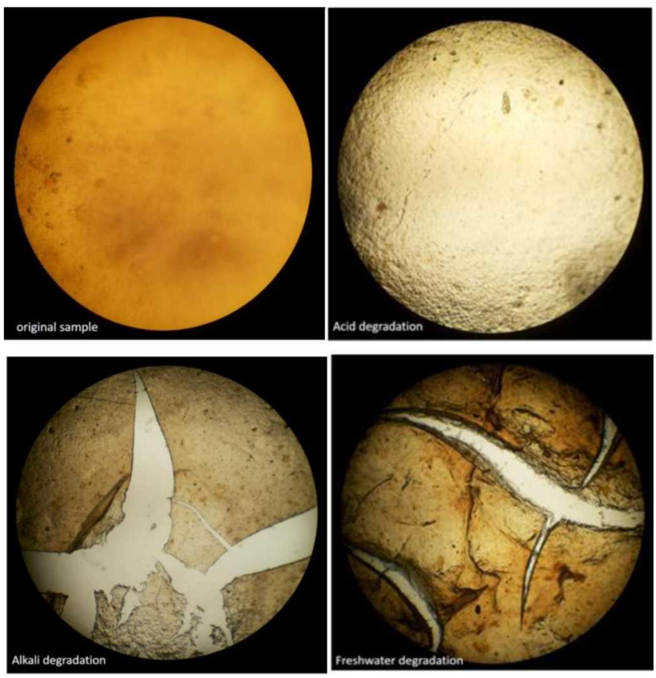
Alkali extraction	Native extraction
Lower yield (%16)	Greater yield (36.8%)
Higher gel strength (900 g/cm^2)	lower gel strength (400 g/cm^2)
Higher cost	Lower cost

Natural agar was extracted in a common, comfortable and effective cost (36.8%), while Alkaline treatment before extraction improves of strength (900 g/cm2), giving the produced agar a great importance because it can be used in wide range of applications.

2.2 Biodegradation test

The biodegradation test was carried out by applying 2 g of bioplastics membranes prepared in this study in different water media (fresh water - acid water - alkaline water). After 26 days, we notice that the films are not affected by acidic media and therefore not suitable for biodegradation.

Figure 2 Microscopic images of bioplastics films; biodegradation test in different media



While grooves and scratches are formed in the films placed in the alkaline and water mediums, this is evidence of the decomposition of the sample and consequently lower biodegradation costs since fresh water (tap water) is suitable for the biodegradation of the films prepared in this way.

Conclusion

In this study, agar was extracted from algae in two ways with high yield and good gelling strength, making it a suitable source for many medical industries, especially the environmentally friendly bio-plastics industry. The bio plastics films prepared in this study show excellent degradability in fresh and alkaline water over a period of 26 days, thus reducing their degradation costs. Finally, Knowledge-sharing and information dissemination in the areas of technology development, assessment and transfer, including biotechnology using ICTs in the development of technology databases, information management systems and funding source, manuals of agricultural research institutions, biotechnology and biosafety protocols and communication supported activities, contributes directly in achieving sustainable developing objectives.

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