بسم الله الرحمن الرحيم

MONA MAGHRABY

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

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شبكة المعلومات الجامعية

التوثيق الإلكتروني والميكروفيلم

جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

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MONA MAGHRABY

EFFECT OF GAMMA IRRADIATION ON SOME SELECTED ISOLATES OF MICROALGAE FOR OPTIMIZING BIODIESEL PRODUCTION

By

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B. Sc. (Agric. Microbiology), Faculty of Agriculture, Ain Shams University, 2005

M. Sc. (Agric. Microbiology), Faculty of Agriculture, Ain Shams University, 2014

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ABSTRACT

Marwa Mohamed Mohamed Moussa: Effect of Gamma Irradiation on Some Selected Isolates of Microalgae for Optimizing Biodiesel Production. Unpublished Ph.D. Thesis, Department of Agricultural Microbiology, Faculty of Agriculture, Ain Shams University, 2021.

Biodiesel is primarily composed of fatty acid methyl esters (FAMEs), which constitute one of the most important substitutions of fossil fuel. The vegetable oils, animal fats, and also macro- or microalgal lipids are used as feedstocks for the synthesis of FAMEs. Meanwhile, the physical and chemical characteristics of biodiesel profile are mainly dependent on the distribution and composition of FAMEs used in its synthesis. Hence, this research was aimed to enhance the recovery of lipids from wet microalgal biomass and improve the distribution of FAME profile of microalgae. For that purpose, several factors; consist of cell disruption procedures, organic solvents, optimizing the levels of nutritional and environmental factors, macronutrient depletion, and co-culture approach, were evaluated for their impacts on yields of total extracted lipids and total FAMEs.

Disruption of wet biomass of *Chlamydomonas* sp., *Scenedesmus ecornis*, and *Scenedesmus communis* by the osmotic shock procedure shown its efficiency to enhance the recovery of lipids from algal biomass, by giving the highest yield of total lipids and total FAMEs. As well, a co-solvent of chloroform: methanol 2:1 (v/v) was effective in extracting higher concentrations of total FAMEs, SFAs, and USFAs. According to the used model of RSM (Box–Behnken), the growth and lipids accumulation of microalgae were positively influenced by the increase in nutrients amount. Where, high levels (+1) of $NaNO_3$, K_2HPO_4, and glucose stocks (at 127.5, 13.1, and 65.6 g L^{-1}, respectively) were found to be the optimal concentrations for the tested microalgal species, under heterotrophic cultivation conditions. Additionally, the best productivity of biomass and lipids were achieved at high levels of temperature (28 ºC) and light intensity

(200 µmole photons $m^{-2}s^{-1}$) for all microalgae, while the optimum pH values were dissimilar as per the algal species.

On the other hand, the impact of gamma irradiation differs between the algal species. It has significantly improved the biomass and lipid productivity of *S. ecornis* exposed to 300 Gy dose, while led to a drop in the biomass and lipid production by *S. communis*. Although the growth of *Chlamydomonas* sp. was slightly reduced by irradiation treatment, the lipids accumulation into cells was significantly improved at a dose of 25 Gy. Under the macronutrient-depletion conditions, each microalga has a completely different performance. Both *Chlamydomonas* sp. and *S. communis* exhibited significant lipid yields at N&P-depletion conditions, however *S. ecornis* was more productive under the N-depletion conditions. The use of microalgal co-culture has a positive impact on the productivity of biomass and lipids within 11 days of the cultivation period. For the co-cultures, the ratios of palmitic and oleic acids to the total FAMEs and also to the total SFAs and USFAs, respectively have remarkably improved based on the inoculum volume.

In conclusion, the examined conditions which resulted in higher lipid productivity combined with better contents of palmitic and oleic fatty acids could be recommended for producing high-quality biodiesel from tested microalgae.

Keywords: Biodiesel, Microalgae, *Chlamydomonas* sp., *Scenedesmus ecornis*, *Scenedesmus communis*, Wet biomass, Cell disruption, Organic solvent, Lipid extraction, FAMEs, SFAs, USFAs, Box-Behnken design, Gamma irradiation, Macronutrient depletion, and Co-culture

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