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TECHNOLOGICAL MAPPING OF LED LIGHTING FOR MICROALGAE: A SURVEY OF PATENT DEPOSITS

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Introdução: Microalgae have been extensively researched as important microorganisms in bioprocesses due to their ability to fix atmospheric CO₂ and biosynthesize high value-added secondary metabolites. Due to their narrowband spectrum, light-emitting diodes (LEDs) are now gaining rapid prominence as a light source for microalgae, along with other advantages compared to conventional light sources. Analyzing patent documents offers unique technical knowledge on the current most innovative technologies. It allows us to measure the developments on the topic of interest, promoting accurate choices, and facilitating decision making. **Objetivos:** Therefore, to address the gap in current literature, we assessed the development of LED lighting for microalgae cultures; the respective patent search was carried out through Orbit Intelligence®, and we were able to identify obtained 578 patent families. **Método:** The search strategy was implemented on the advanced search option, and keywords and IPC (International Patent Classification), previously defined, were used to ensure the accuracy of the results. **Resultados:** The first patent found dates from 1974. Besides, patent applications were unexpressive until the past decade, which showed a significant increase in applications, with a 28.88% compound annual growth rate on this period. We observed that biotechnology is the leading technological domains identified with patents among the major nations. Besides, the majority of patent activity is Asian, with China leading, with 333 patent deposits, followed by South Korea (96) and the USA (45). As we accessed the ten main assignees based on their patent activity, we could see that China is also leading with seven applicants, followed by South Korea with two and Japan with one. Analyzing patents status, we could see that among the patents, 67% remain alive, and 33% are dead. Besides leading applications, China secured the highest number of alive documents (119) and presented a very similar outcome; the proportion of applications alive, pending, and dead is essentially the same: 35, 34, and 30%, respectively South Korea holds higher ratios of living patents among its applications (62.5%), whereas the USA has nearly half of the documents alive. As for patents IPC, we could see that most patents were categorized in various technological groups. C12M (Enzymology or Microbiology) was the primary class found on our search. Also, the primary patent subclass (C12M-001) and codes (C12M-001/00) were also found under this class. Furthermore, we analyzed the main IPC classes in distribution with the top 10 deposit countries. China is the country with coverage in almost all ten major IPC codes, followed by South Korea and the USA. **Conclusão:** Ultimately, we can infer that LED light is no longer a promising tool for microalgae cultivation but is well established as a technology since LEDs allow tailoring light emissions towards microalgae requirements. Using LED light for microalgae cultivation is a cost-effective strategy to improve efficiency, maximize

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growth, and high-value-added bioproduct production, which is crucial for successful up-scaling in industrial processes. Hence the technology is expected to grow even more in the years to come.

Palavras-chave: Innovation; Light Emitting Diodes (Leds); Microalgae Culturing Patent Landscape.

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