**GABARITO-ESPELHO**

**PROVA 2**

DATA: \_\_\_/\_\_\_/\_\_\_\_\_

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NOTA: \_\_\_\_\_\_/100

Leia o texto abaixo e responda as questões.

Risk assessment of fungal materials

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1. The world population is predicted to increase to 9.7 billion people in 2050, thereby putting even more pressure on natural resources than is happening today. The materials used in industries are often non-sustainable and dominated by the linear economic model to make, use and dispose. This linear approach is not sustainable and is already taken its toll on global ecosystems. Fungal materials have high potential to replace non-sustainable and/or polluting products and production processes. For instance, they could replace, at least in part, non-sustainable plastics, textiles, leather and construction materials.
2. Petrochemical based plastics are widely used as packaging material. The amount of plastics produced globally amounts over 360 million metric tons per year and has been growing annually by 8.4% in the period 1950–2015. Only 35% of the consumer plastics was recycled in Europe in 2020, 42% was incinerated for energy production, while 23% ended up in landfills. Spreading of (micro-)plastics as litter or from landfills into the environment poses significant hazard to both terrestrial and marine ecosystems.
3. Cotton production also impacts the environment by its high-water demand and intense use of pesticides, while the leather industry uses chemicals such as chrome for tanning. Finally, 4.2 giga tonnes of cement were produced worldwide in 2019, which coincided with a concerning amount of CO2 emissions. Clearly, we need to shift towards a sustainable economy. The use of fungal materials may offer a fundamental change in our current way of manufacturing because these materials are produced from waste streams.
4. Moreover, the fungal materials can be recycled at their end of life to make new materials, to use as feed or fertilizer, or to improve soil structure. In this review, we will discuss the risks of mycelium materials for workers, researchers, consumers and the natural environment due to the fungal life style and the production process of these materials. Based on this, we will make recommendations for their safe introduction on the market.
5. Some of the fungal species that are used or have been proposed to use for mycelium materials have been reported to be pathogens of humans, animals and/or plants. However, none of these animal or human pathogens are considered classical pathogens. The majority of the species that are used to make mycelium materials are white-rot basidiomycetes belonging to the subphylum Agaricomycotina. Some of these wood degrading fungi can incidentally cause disease in human as opportunistic human pathogens. Exposure to high numbers of basidiospores can cause respiratory problems as observed in growers of the oyster mushroom P. ostreatus.
6. Moreover, agaricomycetes can infect humans with a compromised immune system. For instance, a total of 71 S. commune infections (mainly broncho-pulmonary mycosis and sinusitis) have been reported worldwide until 2013. This number of infections should be related to the 57 reported cases of fungemia (until 2003) caused by S. cerevisae that is widely used in baking and brewing and as a probiotic and the 150 million severe cases of fungal infections each year, of which 1.7 million patients die. The opportunistic nature of agaricomycetes makes that one can work with these fungi at the lowest biosafety level during their production, although regulations may differ between countries.
7. Fungi and insects are abundant in nature and they have evolved different interactions. Insects benefit from fungi as food source, mechanical protection and antimicrobial defence. Fungi benefit from insects in a similar way, while insects also serve as a vector for fungal spore dispersal. Fungi are known to produce complex mixtures of volatiles. The composition of volatile compounds can vary depending on growth conditions and developmental stage. Hundreds of volatiles have been identified, including alcohols, aldehydes, esters, phenols and ketones.
8. Volatiles are synthesized as by-products of metabolism and can have a protective or attractive role in interaction with animals. A well-known compound is the alcohol 1-octen-3-ol, which can act both as attractant and repellent depending on the fungus-insect interaction. Female flies are attracted by volatiles to lay eggs on the fruiting body to provide larvae with fungal tissue as a food source. In some cases, this is mutually beneficial when dispersal of fungal propagules by the insect takes place. These interactions can also result in the attraction of generalist predator insects to prey on fungus-insects. Ants can also be attracted to mushrooms. For instance, the ant species Euprenolepis procera is a specialist in harvesting of and living on fruiting bodies.
9. When working with fungi standardisation is key. This is not only essential to compare screens in different laboratories but also to ensure reproducible manufacturing and material properties. For instance, drying of mycelium materials should be standardized. So far, drying is done at room temperature, in an oven, or a drier. An important aspect is the insulation property of mycelium composites, with surrounding material potentially keeping the inner section viable and/or moist. Therefore, studies should unveil viability of mycelium composites after drying and heat treatment by plating and counting colony-forming units. Possibly, substrates, species and materials dimensions as well as methods of drying should be optimized. In addition, studies have to be performed to demonstrate stability of the material in time.
10. Only recently an article assessed the impact of tropical weathering conditions (75 ± 15% relative humidity and 27.5 ± 2.5 °C) on the mechanical properties of composite material. Mechanical properties of uncoated samples substantially dropped over 35 days, whereas applying an oil-based coating reduced the weathering effect, albeit only significant for tensile strength. This was explained by the high porosity of the composite material that prevented the coating from forming a perfect sealed surface, thus enabling moisture from entering. Finally, biodegradability of the mycelium material after use should be assessed as well as the bioavailability of the nutrients contained in the material. So far, these topics have not been addressed in the literature.
11. Fungal materials have a very high potential to replace non-sustainable products on the market. In fact, fungal materials may even have properties that are not yet provided by other materials. Given their potential, fungal materials may be used at a very large scale. In the future, people may be surrounded by these materials in their houses, at work, and may even wear it. This requires a critical assessment of the risks associated with fungal materials. This includes the selection of species used for making the materials, the conditions used during the production process and when they leave the production facility, as well as measures to prevent impact on the environment when the products are used in society. Our assessment of pathogenicity and mycotoxin data indicates that fungal species that have been described in scientific publications to produce fungal materials show low risk, if at all, for workers, consumers and the environment.

(Extracted and adapted from: <https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC8876125/>)

As questões de 1 a 5 são de múltipla escolha. Para cada questão será aceita apenas uma resposta. (Cada questão vale 6, totalizando 30 pontos de 100)

1. De acordo com o parágrafo I, indique a única opção correta:
2. As indústrias que usam materiais não-sustentáveis estão perdendo seu poder de mercado.
3. Materiais de origem fúngica são pouco utilizados de forma global.
4. As indústrias estão mudando sua forma de abordagem para algo mais linear e autossustentável.
5. **O alto potencial dos materiais fúngicos poderia substituir materiais não-sustentáveis.**
6. O modelo econômico linear tem provado ser autossustentável em seu processo de produção.
7. Sobre o uso do plástico pela indústria (parágrafo II), marque a opção correta:
8. O continente europeu é líder em reciclagem de plástico.
9. **A produção de plástico teve um aumento de mais de 8% ao ano entre 1950 e 2015.**
10. A maioria do plástico consumido na Europa é reciclada.
11. Os aterros sanitários detêm a maior quantidade de lixo plástico consumido na Europa.
12. Mais de 360 milhões de toneladas de plástico foram incineradas na Europa em 2020.
13. De acordo com o parágrafo III, é correto afirmar:
14. A produção de algodão impacta na contaminação da água através de pesticidas.
15. A produção de couro tem aumentado a demanda por produtos químicos derivados do cromo.
16. **O aumento na produção de cimento coincide com o significante aumento de emissão de CO2.**
17. O uso de matérias primas fúngicas diminui o impacto residual provocado pela indústria química.
18. Os materiais fúngicos são fundamentais para a manufatura de resíduos.
19. Qual é o objetivo do texto em questão (parágrafo IV)?
20. Alertar sobre o impacto causado pelo processo industrial não-sustentável.
21. Discutir sobre o uso indiscriminado do micélio como fertilizante.
22. Analisar os recursos disponíveis para a produção de fungos no meio-ambiente.
23. **Debater sobre os riscos e o processo de produção de materiais provenientes do micélio.**
24. Informar sobre a atual quantidade de materiais fúngicos na produção industrial.
25. Segundo o parágrafo V, está correto afirmar:
26. **Algumas espécies de fungos utilizadas para produzir micélio causam doenças em humanos, animais e plantas.**
27. Algumas espécies de fungos utilizadas para produzir micélio atuam como preventores de enfermidades tanto em humanos como em animais e plantas.
28. Algumas espécies de fungos podem produzir uma quantidade de micélio superior à suportada por humanos, animais e plantas.
29. Algumas espécies de fungos produtores de micélio pertencem ao subfilo *Agaricomycotina*.
30. Algumas espécies de fungos produtores de micélio são encontradas em cogumelos.

Responda as questões a seguir em língua portuguesa. (Cada questão vale 8, totalizando 40 pontos de 100)

1. Que tipo de fungo tem causado milhões de casos severos de infecção todos os anos (parágrafo VI)?

**S. cerevisae*that is widely used in baking and brewing and as a probiotic.***

(S. cerevisae, levedura de cerveja)

1. Como os insetos se beneficiam dos fungos (parágrafo VII)?

***Insects benefit from fungi as food source, mechanical protection and antimicrobial defence.***

(Os insetos se beneficiam dos fungos como fonte de alimento, proteção mecânica e defesa antimicróbica.)

1. De acordo com o tipo de interação entre fungos e insetos, como atua o composto alcoólico volátil álcool-1-octen-e-ol (parágrafo VIII)?

***It can act both as attractant and repellent depending on the fungus-insect interaction.***

(Pode atuar tanto como atrativo como repelente).

1. Por que a secagem de materiais de micélio deve ser padronizada (parágrafo IX)?

***To compare screens in different laboratories but also to ensure reproducible manufacturing and material properties.***

(Para comparar telas em diversos laboratórios e assegurar as propriedades reprodutivas de fabricação e material.)

1. Que temas com relação ao material de micélio ainda não foram abordados teoricamente (parágrafo X)?

***Biodegradability of the mycelium material after use should be assessed as well as the bioavailability of the nutrients contained in the material.***

(A avaliação da biodegradabilidade do material de micélio após o uso, bem como a disponibilidade dos nutrientes contidos no material.)

Tradução –

Converta para o português a passagem a seguir extraída do texto em questão (total de 30 pontos de 100):

*Fungal materials have a very high potential to replace non-sustainable products on the market. In fact, fungal materials may even have properties that are not yet provided by other materials. Given their potential, fungal materials may be used at a very large scale. In the future, people may be surrounded by these materials in their houses, at work, and may even wear it. This requires a critical assessment of the risks associated with fungal materials. This includes the selection of species used for making the materials, the conditions used during the production process and when they leave the production facility, as well as measures to prevent impact on the environment when the products are used in society. Our assessment of pathogenicity and mycotoxin data indicates that fungal species that have been described in scientific publications to produce fungal materials show low risk, if at all, for workers, consumers and the environment.*

(Os materiais fúngicos têm um potencial muito alto para substituir produtos não sustentáveis ​​no mercado. De fato, os materiais fúngicos podem até ter propriedades que ainda não são fornecidas por outros materiais. Dado o seu potencial, os materiais fúngicos podem ser usados ​​em grande escala. No futuro, as pessoas poderão estar cercadas por esses materiais em suas casas, no trabalho e poderão até usá-los. Isso requer uma avaliação crítica dos riscos associados aos materiais fúngicos. Isso inclui a seleção das espécies utilizadas para a fabricação dos materiais, as condições utilizadas durante o processo de produção e quando saem da unidade de produção, bem como medidas para evitar impactos ao meio ambiente quando os produtos são utilizados na sociedade. Nossa avaliação dos dados de patogenicidade e micotoxinas indica que as espécies de fungos que foram descritas em publicações científicas para produzir materiais fúngicos apresentam baixo risco, se houver, para trabalhadores, consumidores e meio ambiente.)