Mushroom Technology Literature Review

Abstract
Over 2.5 billion people do not have safe and dignified toilet. Piped water sewage systems are not viable in remote, dry, and rapidly developing areas. The waste substrate remaining after growing mushrooms can be added to dry toilets and pit latrines to control smell and treat the waste.

Background
This project builds on the masters research conducted by (Urieli, 2016) where Pleurotus fungi was used to control the smell of human faeces. Further unpublished results indicate that Pleurotus inhibit E. coli bacteria. This raises the possibility of Pleurotus being used as a novel sanitation treatment method.

The key pathogen groups in sanitation treatment are bacteria, viruses, protozoa and helminths (Strande, Ronteltap, & Brdjanovic, 2014). (Andersson et al., 2003; Šnajdr & Baldrian, 2006) show that fungi have a negative effect on bacteria populations, more specifically (Oyetayo & Ariyo, 2013) has shown that Pluerotus ostreatus could completely inhibit a range of bacteria. A verity of fungi decrease the viability of Helminth eggs (Blaszkowska, Wojcik, Kurnatowski, & Szwabe, 2013; Larsen, 1999), in particular Pleurotus pulmonarius exerts a strong immobilising effect on preinfective larvae of animal parasitic nematodes (Larsen & Nansen, 1991). Despite a lack of literature on the ability of Pleurotus spp. to control viruses and protozoa, the literature indicates Pleurotus spp. as a promising candidate for use in sanitation treatment.

With an estimated 1.5 billion people using pit latrines worldwide (WHO & UNICEF, 2014), Pleurotus could be used as a low-tech, distributed, insitu sanitation treatment. Currently pit latrines contaminate the local environment and are hazardous to empty. A Pleurotus additive for pit latrines could remove the malodour rendering the additive marketable as a “Smell Stopper”. The additive would also decrease or remove the pathogens in the waste, making the waste easier or safe to handle and dispose of in the local environment. A Pleurotus additive could be easily distributed as it is safe, extensively researched, and widely available due to its use a food source (Cohen, Persky, & Hadar, 2002).

80% of the mushroom mass produced during food production is the waste mycelium that cannot be sold as food. Spent Pleurotus substrate is a widely available waste that has already been shown to:
• Purify water by reducing phenol content and toxicity in olive mill waste (Martirani, Giardina, Marzullo, & Sannia, 1996)
• Purify soil to remove biocide pentachlorophenol (Chiu, Ching, Fong, & Moore, 1998)
• Fertilise lettuce seedlings leading to increased yields (Marques et al., 2014)
• Produce lignocellulosic enzymes for industrial applications (Phan & Sabaratnam, 2012)
• As a foodstuff for a variety of livestock (Rinker, 2002)
• A general soil supplement (Rinker, 2002)
• Combined with fresh substrate and re-inoculated (Rinker, 2002)
• Biogas production (Rinker, 2002)

Further Research
The first area of research is need to confirm that Pleurotus spp. are better at pathogen reduction than other candidates such as Stropharia used in mycofiltration (Taylor, Flatt, Wolff, Brownson, & Stamets, 2015) or Coprophilous fungi such as Coprinopsis cinerea, that grown in faeces and are known to excrete antibacterial substances (Essig et al., 2014).

The extent of the pathogen reduction is another question. Pleurotus will produce a local inhibition of bacteria (Oyetayo & Ariyo, 2013), it will need to found whether this is extends throughout the pit latrine. Not all Helminth eggs are rendered non-viable by Pleurotus (Larsen & Nansen, 1991), the degree of successful treatment will need to be accessed. Finally the effect of Pleurotus on protozoa and viruses is unknown.

Citations


Ecological Engineering, 78, 79-86.
http://doi.org/10.1016/j.ecoleng.2014.05.016
Urieli, J. (2016). PooPac: Revolutionising container sanitation to securely transport waste at scale. The Zurich University of Arts.