

Bio-Manufacturing Tree-of-heaven

ORGANIC AGRICULTURAL REMEDY FROM THE INVASIVE TREE

Despite its invasive nature, the **Tree-of-heaven (*Ailanthus altissima*)** is resilient and grows quickly. It also contains valuable bioactive substances that may have uses in agriculture. These substances are converted into potent organic agricultural medicines by employing sophisticated extraction techniques. Against this backdrop, a pivotal aspect of the bio-manufacturing experiment using the invasive **Tree-of-heaven (*Ailanthus altissima*)** was explored by the **University of Johannesburg's Process, Energy & Environmental Technology Station (UJ PEETS)**.

The first step in **UJ PEETS'** engagement was to discover and characterise the bioactive compounds present in the tree, as well as to create innovative extraction techniques for the effective isolation of these compounds. To guarantee the consistency and quality of the extracts, the project involved the optimisation of process parameters to determine the possibility of carrying out lab-scale extractions.

To determine the viability of lab-scale extractions from **Tree-of-heaven (*Ailanthus altissima*)** lab-scale trials were carried out, solvent choices were assessed, and most importantly extraction parameters were adjusted.

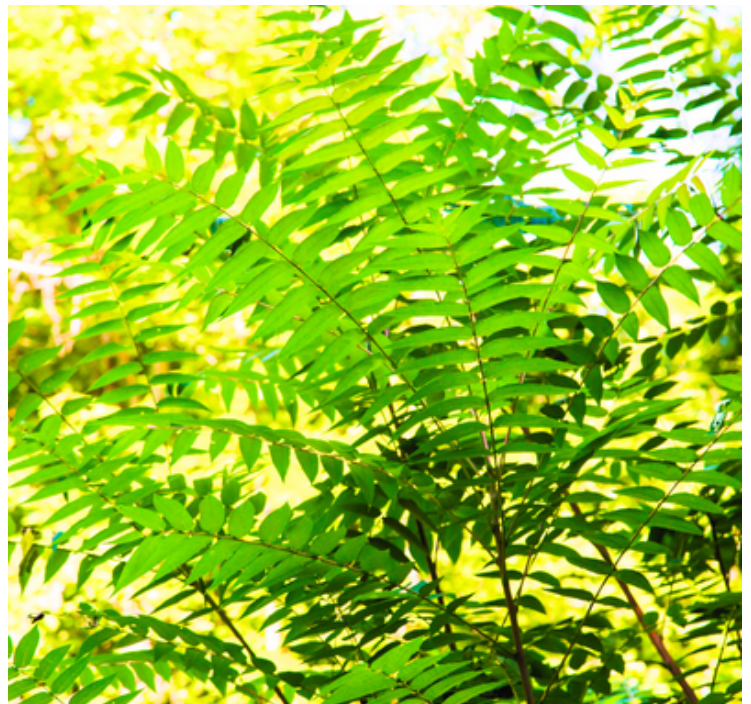


Figure 1: Tree-of-heaven, *Ailanthus altissima*

Extraction is one of the best ways of getting beneficial components from plants, that have drug-like characteristics, however the process can be labour-intensive and time-consuming. Therefore, the isolation of bioactive natural compounds must be advanced through the development of innovative and efficient extraction techniques. This extensive participation guaranteed both the project's possible influence on sustainable agriculture and its success.

Methods of Extraction

The first stage in acquiring desired natural products from raw sources is extraction. The principal extraction techniques are solvent extraction, distillation, pressing, and sublimation. The most used approach is solvent extraction. There are multiple steps involved:

1. The solid matrix is penetrated by the solvent.
2. In the solvents, the solute dissolves.
3. From the solid matrix, the solute diffuses out.
4. The solutes that are removed are gathered.

The extraction process is facilitated by factors that increase diffusivity and solubility at various phases. These variables include the solvent's characteristics, the raw materials' particle sizes, the ratio of solvent to solid, the temperature during extraction, and the length of time.

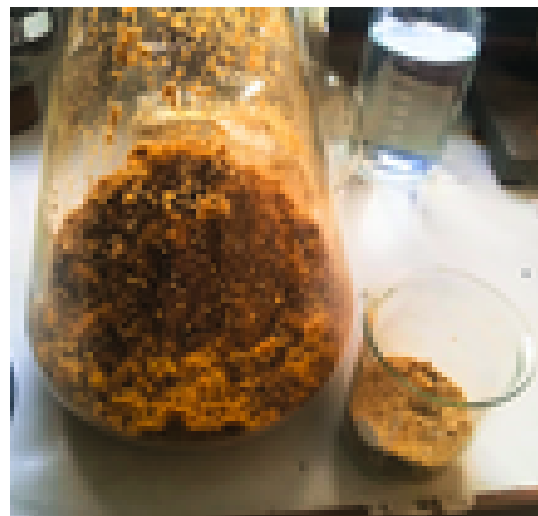


Figure 2: *Ailanthus altissima* plant material

Solvent Selection

While high temperatures encourage solubility and diffusion, they also cause heat-sensitive components to deteriorate and lose their solvent. Longer extraction times result in higher extraction efficiency until solute equilibrium is reached.

Higher extraction rates are often achieved with larger solvent-to-solid ratios; however, overly high ratios may lead to solvent abuse and prolonged concentration durations. Traditional extraction techniques including reflux extraction, percolation, and maceration frequently call for high solvent volumes and lengthy extraction times. Increased selectivity, shorter extraction periods, and less solvent use are just a few benefits of contemporary, eco-friendly extraction methods as pressurised liquid extraction (PLE), supercritical fluid extraction (SFC), and microwave-assisted extraction (MAE). These modern techniques offer more effective and environmentally friendly ways to extract natural resources.



Figure 3: Solvent system extraction method set up



Figure 4: Samples 1, 2 & 3



Figure 5: Mill grinder



Figure 6: Solvent system extraction method set up

Utilising Tree-of-heaven

The tree-of-heaven plant is used in folk medicine. The dried bark from the trunk and root are used for diarrhea, asthma, cramps, epilepsy, fast heart rate, and gonorrhoea. The herb is applied as a pesticide. It has also been utilised as a tonic and bitter. Tree-of-heaven is used by some women to treat menstruation pain and vaginal infections. The tender leaves of the tree-of-heaven are consumed as food.

Conclusion

Making use of the invasive **Tree-of-heaven** for bio-manufacturing presents a special chance to transform an environmental issue into a useful resource. These techniques not only improve the efficacy and efficiency of bioactive component extraction, but they also support sustainable farming approaches. This novel strategy helps to create a greener future by opening the door for more environmentally friendly ways to combat pests and illnesses in agriculture.

The **University of Johannesburg's Process, Energy and Environmental Technology Station (UJ PEETS)** aims to enhance industry competitiveness in the green circular economy through specialised knowledge and technology transfer. UJ PEETS connects academia, industry (especially SMEs), and government, supporting capacity-building and policy initiatives to grow the green economy and providing engineering and technology support to SMEs.