Therapeutic monoclonal antibodies (mAb) are a type of medical treatment that specifically targets diseased cells in the body. Once targeted, these cells are destroyed by the immune system or, in the case of cancer, the mAbs may stop the cells from growing.

Trastuzumab is a therapeutic mAb that has been approved for clinical use (its trade name is Herceptin). It only works against certain types of breast cancer, as it recognizes and binds to cancer cells that have an excess of a molecule called HER2.

Large doses of mAbs are often required for successful treatment, and current methods of production are time-consuming and expensive. Plant-based systems are a possible alternative production method; these “biopharming” processes use genetically-modified plants to make large quantities of antibodies in a much shorter time and to reduce costs associated with producing the final products. The purpose of this study is to compare the effectiveness of the molecule that was produced in a plant “bioreactor” (trastuzumab) with the commercially available Herceptin (which was produced in the traditional manner).

This summary is a project of the Institute for Community Engaged Scholarship (ICES) at the University of Guelph, with project partners: the Catalyst Centre, SPARK Program at the University of Guelph, and the Knowledge Mobilization Unit at York University. This project is part of the Pan-Canadian Research Impact Network. http://csahs.uoguelph.ca/pps/Clear_Research

What is this research about?
Therapeutic monoclonal antibodies (mAb) are a type of medical treatment that specifically targets diseased cells in the body. Once targeted, these cells are destroyed by the immune system or, in the case of cancer, the mAbs may stop the cells from growing. Trastuzumab is a therapeutic mAb that has been approved for clinical use (its trade name is Herceptin). It only works against certain types of breast cancer, as it recognizes and binds to cancer cells that have an excess of a molecule called HER2.

Large doses of mAbs are often required for successful treatment, and current methods of production are time-consuming and expensive. Plant-based systems are a possible alternative production method; these “biopharming” processes use genetically-modified plants to make large quantities of antibodies in a much shorter time and to reduce costs associated with producing the final products. The purpose of this study is to compare the effectiveness of the molecule that was produced in a plant “bioreactor” (trastuzumab) with the commercially available Herceptin (which was produced in the traditional manner).

What did the researchers do?
The genetic information for making trastuzumab was introduced into experimental plants. After 8 days of growth the leaves were harvested, the trastuzumab was isolated, and its structure was compared to that of (traditionally-produced) Herceptin. Finally, equal amounts of either trastuzumab or Herceptin were added to three types of human breast cancer cells: two types had an excess of HER2 surface molecules, and one had a normal level of HER2. Researchers measured the number of live cancer cells every 2 days for an 8 day period to compare the effectiveness of the two medicines.
**What did the researchers find?**

Plant-produced trastuzumab and traditionally-produced Herceptin behaved similarly in a range of tests. The protein structures of trastuzumab and Herceptin were similar, as was their ability to bind to HER2. Both trastuzumab and Herceptin had similar effects on all three of the breast cancer cell types that were tested: they both inhibited the growth of breast cancer cells with high HER2 levels, and they had no effect on the cell type with normal HER2 levels. On average, the plants produced approximately 43 milligrams of trastuzumab per kilogram of fresh leaf tissue.

**Keywords:**
Breast cancer, HER2, therapeutic antibody, biopharming, Herceptin, trastuzumab

---

**About the University of Guelph researcher:**

Christopher Hall is a Professor in the School of Environmental Sciences at the University of Guelph. Email: jchall@uoguelph.ca

**Article citation:**


**How can you use this research?**

- **Oncologists** can use this research to understand the suitability of new plant-based production systems for therapeutic antibodies.
- **Pharmaceutical companies** can use this research to evaluate new, more cost-effective methods of producing pharmaceuticals such as therapeutic antibodies.
- **Scientists** can further this research by finding more efficient ways to produce and purify antibodies and other biopharmaceuticals from plants. They can also ensure that agents produced by plant-based systems are identical to those made by existing methods.

**Cite this work:**


---

This work is licensed under the Creative Commons Attribution-NoDerivs 3.0 Unported