

# Mining Proteomics Data

## Protein phosphorylation in intracellular *Toxoplasma* tachyzoites

### Learning objectives

- Explore proteomics data on VEuPathDB
- Perform a Post-Translational Modification search for genes with

### Introduction

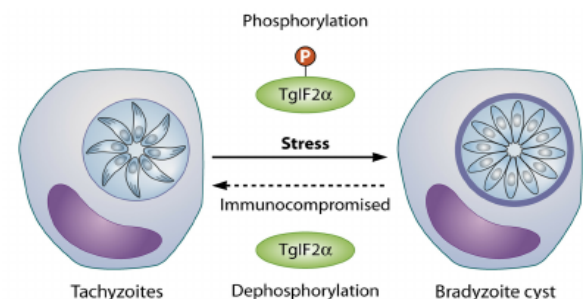
Protein phosphorylation in intracellular *Toxoplasma* tachyzoites is a crucial **post-translational modification** that regulates various aspects of the parasite's life cycle, including invasion, egress, motility, and adaptation to the host cell environment, primarily by controlling the activity and localization of key proteins involved in these processes. It is considered a critical mechanism for the parasite's survival and virulence within the host cell.

In this exercise, the goal is to **find genes with evidence of protein phosphorylation in intracellular *Toxoplasma* tachyzoites**.

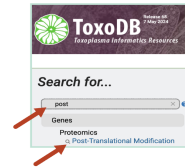
Additionally, we want to determine how many of these phosphorylated genes are also localized to the microneme, the secretory organelle that plays a critical role in the survival and spread of the parasite.

**Overview of the search strategy:** Use Post-Translational Modification search in two steps

- identify genes that have phosphorylation events
- intersect that search with a micromene localization search



1. Navigate to [ToxoDB.org](https://toxodb.org)
2. From the sidebar or header, search for “post” and click on **Post-Translational Modification**



3. Configure the search to have at least 5 phosphorylation events from all available phosphoproteomic experiments in *Toxoplasma*.  
How many genes did you get? Which gene has the highest number of phosphorylation sites?

# Identify Genes based on Post-Translational Modification

Configure Search

Learn More

View Data Sets Used

Reset values to default

Type of Post-Translational Modification

phosphorylation site

Experiments and Samples

14 selected, out of 14

select all | clear all | expand all | collapse all

Filter list below...

▼

☒ Toxoplasma gondii

☒ Toxoplasma gondii GT1

☒ Toxoplasma gondii ME49

☐ Reference only

Number of modifications is

Greater than or equal to

Number of Modifications

5

Get Answer

The screenshot shows the Phylo-P 4.0.2 web interface. At the top, the search term "Toxoplasma phosphorylation" is entered. Below the search bar, there is a "Post-Translational Mod" button and a "+ Add a step" button. A red arrow points to the "Post-Translational Mod" button. The search results show "2,800 Genes (1,806 ortholog groups)". A red box highlights the "Total Modified Residues" column in the results table.

4. How many of these phosphorylated genes are also localized to the microneme organelles?

Add a step to your search strategy to limit to genes expressed in the microneme. ToxoDB has hyperLOPIT data (Hyperplexed Localisation of Organelle Proteins by Isotope Tagging), a spatial proteomics method that simultaneously captures the steady-state subcellular association of thousands of proteins. The technique reveals the probability that a protein is present in a specific cellular location (fraction). Use this data and search to find which phosphorylated genes are localized to the microneme.

The process involves refining a search strategy in ToxoDB to find genes that are both phosphorylated and localized to the microneme.

**Step 1:** The initial search is for "Toxoplasma phosphorylation", resulting in 2,800 genes.

**Step 2:** A new step is added to the search strategy. The "Choose how to combine with other Genes" section shows the selection of "1 INTERSECT 2". The "Choose which Genes to combine. From..." section shows the selection of "A new search".

**Step 3:** The "Add a step to your search strategy" dialog is shown. The "Method" is set to "TAGM-MAP (default)". The "Subcellular location probabilities" section is expanded, showing a histogram of "Any compartments probability" for 3,827 genes. The "micron" filter is selected, and the "No filters applied" message is displayed.

**Step 4:** The final search results are displayed, showing 824 genes. The search strategy is summarized as: "Toxoplasma phosphorylation" (Step 1) AND "LOPIT" (Step 2) = 824 Genes.

How many genes did you get that are phosphorylated and that localize to the microneme?