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# *Unlabeled Pentamer Staining Protocol*

## *Materials Required*

- Cell sample, e.g. Blood sample (RBC-depleted), PBMCs or T cell line
- Unlabeled Pro5® Recombinant MHC Pentamer (either Pro5® MHC Pentamers or ProVE™ Pentamers). *Ensure that the stock Pentamer is stored consistently at 4ºC or -80ºC, with the lid tightly closed.*
- Pro5® Fluorotag conjugated to the fluorescent label of choice. *Ensure that the Fluorotag is stored consistently at 4ºC in the dark, with the lid tightly closed.*
- Fluorescent-labeled anti-CD8 and anti-CD19 antibodies
- Wash buffer (0.1% sodium azide, 0.1% BSA in PBS)
- Fix solution (1% fetal calf serum, 2.5% formaldehyde in PBS)

## *Standard Staining Protocol*

1. **Spin Pro5® Fluorotag in a chilled microcentrifuge at 14,000 × *g* for 3 minutes.** This will remove protein aggregates that contribute to non-specific staining. Maintain reagents on ice, shielded from light, until required. Do not aspirate any part of the pelleted aggregates when taking test volumes for staining.
2. **Allocate 1-2 ´ 10$^6$ lymphoid cells (PBMC or splenocytes) per staining condition.** This ensures there is a sufficient number of cells to collect up to 500,000 events during flow cytometry.

   **(Allocate only 2-5 ´ 10$^5$ cells per staining condition when using T cell clones or lines due to the high frequency of antigen-specific T cells).**
3. **Wash cells* with wash buffer and resuspend in the residual volume (~ 50ml).** Keep tubes chilled on ice for all subsequent steps, except where otherwise indicated.
4. **Add one test of unlabeled Pentamer (2 ml Pro5® MHC Pentamer or 0.5 mg ProVE™ Pentamer) to the cells and mix by pipetting.**
5. **Incubate at room temperature (22ºC) for 10 minutes.**
6. **Wash cells with 2ml wash buffer per tube and resuspend in residual liquid (~ 50ml).**
7. **Add 8 ml Pro5® Fluorotag and optimal amounts of anti-CD8 and anti-CD19† antibodies (and any other secondary antibodies) and mix by pipetting.** If staining control samples with other primary antibodies, at this stage add an optimal amount to the cells in their respective tubes.
8. **Incubate samples on ice for 20 minutes, shielded from light.**
9. **Wash cells twice with 2ml wash buffer per tube. Mix each tube.**
10. **Add 200ml fix solution. Vortex tubes.** It is important to vortex well when adding fixative so that cells do not clump. Store tubes in the dark in the refrigerator until ready for data acquisition. The morphology of the cell changes after fixing, so it is advisable to leave the samples for 3 hours before proceeding with data acquisition. Samples can be stored for up to 2 days.

    **The cells are now ready for flow cytometric analysis.** The Pentamer-positive cells are most conveniently viewed by gating first on live, CD19-negative lymphoid cells and then analyzing on a two-color plot showing CD8 on the x-axis and Pentamer on the y-axis.

* To wash cells: Dispense 1 ml wash buffer per tube and spin 500 × *g* for 5 minutes in a chilled centrifuge at 4ºC. Check for presence of a cell pellet before discarding the supernatant.

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## *Protocol Optimization*

The detection of rare antigen-specific T cells by Pro5® Pentamer staining is a powerful and versatile tool for immunological analysis. However, the detection of events as rare as 0.02% of total $CD8^+$ T cells requires both the design of suitably controlled experiments as well as a well-maintained flow cytometer. If the number of Pro5® Pentamer-positive events is expected to be low, it is important to acquire a suitably large number of events within the live lymphocyte gate in order to collect sufficient events of the population of interest.
The binding affinity of the MHC molecule for the TCR varies depending on the allele/peptide combination. This means that different complexes will have slightly different characteristics in the way they stain. The following guidelines will assist with protocol optimization for the best possible results:

***Setting the live lymphocyte gate*** It is important to ensure that the forward-scatter (FSC) and side-scatter (SSC) gates are set correctly on the cell population of interest. For further information and examples, please visit http://proimmune.com/ecommerce/page.php?page=protocol_optimization.

***Find the optimum quantity of Pentamer and/or Fluorotag to use*** Although a single test quantity of Pro5® Pentamer and Fluorotag should normally be sufficient to stain 1 - 2 × $10^6$ cells, it is important to first titrate them both. Carry out a range of doubling dilutions from 1 test per 1 × $10^6$ cells down to 1/16 test per 1 × $10^6$ cells.

***CD8 antibody*** Investigate the effect of titrating the anti-CD8 antibody. This will prevent any antibody-mediated blocking of the Pro5® Pentamer-binding site.

†***Reduction of background staining*** Pro5® Pentamers may bind non-specifically to B cells. It is therefore strongly recommended to include an anti-CD19 antibody when staining in order to gate on CD19-negative cells before plotting Pentamer versus CD8.

***Temperature*** The temperature at which cells are stained with Pro5® Pentamer can affect the background considerably. Although staining with Pro5® Pentamer at room temperature (22°C) is recommended in the first instance, incubating at 4°C or 37°C may be beneficial in optimizing the signal to noise ratio depending upon the MHC/peptide combination. The higher the incubation temperature, the shorter the incubation time required.

***Positive control*** Pro5® Pentamers should be tested against a specific T cell line (or clone). Be sure to use T cells that have not been recently stimulated as this has been shown to cause down-regulation of T cell receptors. If a T cell line is not available it is possible to use PBMCs from a known positive donor. In this situation the frequency of positive cells will be much lower and more cells will be required (at least 1 × $10^6$) per stain.

***Negative control*** To control for non-specific staining it is also useful to stain T cells of a different peptide specificity or MHC restriction. For example, T cells from unexposed individuals may be used when detecting T cell responses to a specific antigen.

***Use of previously frozen cells*** Pro5® Pentamers can also be used to stain frozen PBMC samples, although the number of live cells will be reduced. Thaw the cells carefully and wash twice before proceeding with the staining protocol.

***Ficoll purification*** of cells before use may reduce background staining (this has been reported to be particularly beneficial with mouse splenocytes). Increasing the concentration of azide in the wash buffer may also reduce any background.

***Intracellular staining*** It is possible to co-stain samples with antibodies against intracellular markers. Cells should first be stained with the Pro5® Pentamer and other antibodies specific for extracellular epitopes, followed by membrane permeabilization and intracellular staining. Please contact us for a detailed protocol.

***Fluorescence Activated Cell Sorting*** Live, Pro5® Pentamer-positive cells can be sorted and collected for further manipulation. In this case it is necessary to remove the azide preservative in the Pro5® Pentamer reagent beforehand, using centrifugal concentrators (e.g. Microcon 10kD from Millipore). Dilute the reagent to maximum volume with PBS and concentrate down to original volume. Repeat the procedure 2-3 times until the azide is sufficiently diluted. Ensure appropriate amounts of Pro5® Pentamer reagent, Pro5® Fluorotag and other antibodies are used, and sort the cells immediately after staining, without fixing. If sorting a large number of cells then chill the tube during the procedure to prevent clumping.

***Choice of fluorescent label*** Pro5® Pentamers can be visualized with R-Phycoerythrin (R-PE)- or APC-labeled Pro5® Fluorotags. R-PE is most commonly used as it stains very brightly.

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