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1. Description

This product is for research use only.

Components	6 nmol/peptide PepTivator® SARS-CoV-2 Prot_N B.1.1.7 Mutation Pool – research grade: Pool of 9 peptides covering all 4 mutations of the nucleocapsid phosphoprotein (“N”) in the SARS-CoV-2 variant B.1.1.7.
Capacity	6 nmol (approximately 10 µg) per peptide for stimulation of up to 10 ⁸ total cells.
Product format	Lyophilized peptides containing stabilizer.
Purity	Average purity of peptides >70% (HPLC).
Storage	Store lyophilized product at –20 °C. The expiration date is indicated on the vial label.

This product contains no preservative; always handle under aseptic conditions.

1.1 Background information

SARS-CoV-2 (severe acute respiratory syndrome coronavirus 2) was first detected in December 2019 in Wuhan, China. Since that time the virus kept mutating, leading to new virus variants. The B.1.1.7 lineage, also known as VUI202012/01 or VOC202012/01, is a SARS-CoV-2 variant that was first discovered in Kent, UK in September 2020. The mutations of this variant affect also immune relevant parts of structural SARS-CoV-2 proteins and the respective sequences are available in GISAID, a genome data base, e.g. reference sequence EPI_ISL_756151. The B.1.1.7 lineage has been found to be more infectious than former variants and has become quickly the dominant strain in the UK.

In total there are 4 mutations in the nucleocapsid phosphoprotein (“N”) of the B.1.1.7 lineage compared to the Wuhan variant (reference genome GenBank MN908947.3): D3L, R203K, G204R,

S235F.

The PepTivator® SARS-CoV-2 Prot_N B.1.1.7 Mutation Pool covers selectively the mutated regions. It consists of 9 peptides of 15 aa length. The PepTivator® SARS-CoV-2 Prot_N B.1.1.7 Mutation Pool can be used to supplement PepTivators covering the sequence of the wild-type nucleocapsid phosphoprotein (“N”) in order to detect immune responses towards both variants, Wuhan (wild-type) variant and B.1.1.7 lineage. For control purposes a respective wild-type (WT) reference pool consisting of the 9 homologous peptides of the Wuhan sequence is available. Comparison of the T cell immune response upon stimulation with mutation or reference pool can be used to analyze mutation-specific T cell responses.

The PepTivator® Peptide Pools have been specially developed for efficient *in vitro* stimulation of antigen-specific CD4⁺ and CD8⁺ T cells in various applications. Stimulation of T cells with PepTivator Peptide Pools causes the secretion of effector cytokines and upregulation of activation markers, which then allows the detection or isolation of antigen-specific T cells. Quantitative, phenotypical, or functional analysis of antigen-specific T cell immunity can provide important information on the natural course of immune responses in healthy or immunocompromised individuals.

1.2 Applications

- Detection and analysis of antigen-specific CD4⁺ and CD8⁺ effector/memory T cells, for example, in peripheral blood mononuclear cells (PBMCs), by MACS® Cytokine Secretion Assays, intracellular cytokine staining, or other technologies.
- Isolation of viable antigen-specific CD4⁺ T cells with the CD154 MicroBead Kit, human.
- Isolation of viable antigen-specific CD4⁺ and CD8⁺ T cells using MACS Cytokine Secretion Assay – Cell Enrichment and Detection Kits or the CD137 MicroBead Kit, human for *in vitro* generation of T cell lines/clones.
- Generation of antigen-specific CD4⁺ and CD8⁺ effector/memory T cells from naive T cell populations for research on immunotherapy and vaccination.
- Pulsing of antigen-presenting cells for research on dendritic cell vaccination.

2. Recommendations for *in vitro* restimulation of antigen-specific T cells with PepTivator® Peptide Pools

2.1 Cell preparation

For induction of cytokine secretion by antigen-specific T cells, best results are achieved by stimulation of fresh PBMCs, whole blood, or other leukocyte-containing single-cell preparations from tissues or cell lines. Alternatively, frozen cell preparations can be used.

▲ **Note:** Remove platelets after density gradient separation. Resuspend cell pellet, fill tube with buffer, and mix. Centrifuge at 200×g for 10–15 minutes at 20 °C. Carefully remove supernatant.

▲ **Note:** PBMCs may be stored overnight. The cells should be resuspended

and incubated in culture medium as described in 2.4, steps 1–3, but without addition of antigen. The antigen is then added to the culture on the next day.

For details about cell preparation refer to the protocols section at www.miltenyibiotec.com/protocols.

2.2 Reagent requirements

- Culture medium, e.g., TexMACS™ Medium (# 130-097-196) or RPMI 1640 containing 5% human serum, e.g., autologous or AB serum.
▲ **Note:** Do not use bovine serum albumin (BSA) or fetal bovine serum (FBS) because of non-specific stimulation.
- (Optional) Kits for the isolation and/or detection of cytokine-secreting T cells, e.g., IL-4 Secretion Assay – Cell Enrichment and Detection Kit (PE), human (# 130-054-101).
- (Optional) Antibodies or kits for intracellular cytokine staining e.g., IFN- γ Antibody, anti-human, PE. For more information about antibodies refer to www.miltenyibiotec.com/antibodies.
- (Optional) CD154 MicroBead Kit, human (# 130-092-658) or CD137 MicroBead Kit, human (# 130-093-476).
- (Optional) CytoStim™ (# 130-092-172, # 130-092-173) for restimulation of human T cells.
- (Optional) PepTivator CEF MHC Class I Plus – premium grade (# 130-098-426) as a peptide-specific positive control.

2.3 Recommendations for reconstitution of PepTivator® Peptide Pools

1. For reconstitution of the lyophilized peptide pool take the vial from –20 °C and warm-up to room temperature.
▲ **Note:** Do not open the vial by removing the rubber plug.
2. To dissolve the 6 nmol PepTivator® Peptide Pool fill a sterile syringe (0.5 mL) with 200 μ L of sterile water.
3. Slowly inject the water with a sterile needle through the center of the rubber plug into the vial containing the lyophilized peptide pool.
4. Vortex the solution to completely dissolve the lyophilized peptide pool.
The concentration of the stock solution of PepTivator Peptides is 30 nmol (approximately 50 μ g) of each peptide per mL.
5. Remove the rubber plug and aspirate the stock solution with a pipette.
6. To avoid repeated freeze-thaw cycles prepare working aliquots from the stock solution.
7. Store the working aliquots at –80 °C.

2.4 Recommendations for *in vitro* restimulation of antigen-specific T cells

▲ Coronavirus-specific T cells are expected to be present only in certain individuals. Their frequency may be low compared to T cells with other specificities. The given protocol for *in vitro* T cell stimulation thus may only serve as a guideline.

▲ Magnetic enrichment of stimulated antigen-specific T cells according to cytokine secretion, e.g. IL-17, using the MACS® Secretion Assay Technology or according to expression of activation marker, e.g. CD154, will enhance the sensitivity to detect rare cells.

▲ Always include a negative control (without antigen) in the experiment. As a positive control, a sample stimulated with, e.g. CytoStim, may also be included.

1. Wash cells by adding medium, centrifuge at 300 \times g for 10 minutes. Aspirate supernatant.
2. Resuspend cells in culture medium at 10⁷ cells per mL. Plate cells in dishes at a density of 5 \times 10⁶ cells/cm² (refer to 4. Appendix: Flask and dish sizes for *in vitro* T cell stimulation).
3. Mix the reconstituted PepTivator thoroughly. Add 20 μ L of PepTivator stock solution per mL cell suspension. Mix carefully and incubate cells at 37 °C and 5% CO₂.

The final concentration of PepTivator in the cell suspension is 0.6 nmol (approximately 1 μ g) of each peptide/mL.

Cytokine Secretion Assay: Incubate cells for 3–6 hours.

CD154 MicroBead Kit: Incubate cells for 4–16 hours.

CD137 MicroBead Kit: Incubate cells for 16–24 hours.

Intracellular cytokine staining antibodies or kits: Incubate cells for 2 hours, then add 1 μ g/mL brefeldin A, and incubate for further 4 hours.

4. Collect cells carefully by using a cell scraper, or by pipetting up and down when working with smaller volumes. Rinse the dish with cold buffer. Check microscopically for any remaining cells, if necessary, rinse the dish again.

To proceed with the Cytokine Secretion Assay, the CD154 or CD137 MicroBead Kits, or intracellular cytokine staining, please refer to the respective data sheet.

▲ **Note:** When preparing cells for **intracellular cytokine staining**, fixed cells may be stored at 2–8 °C for up to 1 week.

3. References

1. Rambaut, A. *et al.* (2020) Preliminary genomic characterisation of an emergent SARS-CoV-2 lineage in the UK defined by a novel set of spike mutations. virological.org
2. Vahed, M. *et al.* (2021) Impacts of 203/204: RG>KR mutation in the N protein of SARS-CoV-2. *bioRxiv*, doi: <https://doi.org/10.1101/2021.01.14.426726>.

4. Appendix: Flask and dish sizes for *in vitro* T cell stimulation

For *in vitro* T cell stimulation (refer to 2.4) the cells should be resuspended in culture medium, containing 5% of human serum, at a dilution of 10^7 cells/mL. The cells should be plated at a density of 5×10^6 cells/cm². Both the dilution and the cell density are important to assure optimum stimulation.

The following table lists culture plate, dish and flask sizes suitable for different cell numbers. It also indicates the appropriate amount of medium to add.

Total cell number	Medium volume to add	Culture plate	Well diameter
0.15×10^7	0.15 mL	96 well	0.64 cm
0.50×10^7	0.50 mL	48 well	1.13 cm
1.00×10^7	1.00 mL	24 well	1.60 cm
2.00×10^7	2.00 mL	12 well	2.26 cm
5.00×10^7	5.00 mL	6 well	3.50 cm
Total cell number	Medium volume to add	Culture dish	Dish diameter
4.5×10^7	4.5 mL	small	3.5 cm
10.0×10^7	10.0 mL	medium	6 cm
25.0×10^7	25.0 mL	large	10 cm
50.0×10^7	50.0 mL	extra large	15 cm
Total cell number	Medium volume to add	Culture flask	Growth area
12×10^7	12 mL	50 mL	25 cm ²
40×10^7	40 mL	250 mL	75 cm ²
80×10^7	80 mL	720 mL	162 cm ²
120×10^7	120 mL	900 mL	225 cm ²

Refer to www.miltenyibiotec.com for all data sheets and protocols. Miltenyi Biotec provides technical support worldwide. Visit www.miltenyibiotec.com/local to find your nearest Miltenyi Biotec contact.

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