

Human GM-CSF ELISA Kit

Cat#: orb506669 (Product Manual)

Intended use

The Biorbyt GM-CSF ELISA is an enzyme-linked immunosorbent assay for the quantitative detection of soluble GM-CSF levels in cell culture supernatants, human serum, plasma.

This kit has been configured for research use only.

Introduction

Summary

Granulocyte - macrophage colony - stimulating factor (GM-CSF) is a small glycoprotein growth factor which stimulates the production and function of neutrophils, eosinophils and monocytes (3) GM-CSF can be produced by a wide variety of tissue types, including fibroblasts, endothelial cells, T-cells, macrophages, mesothelial cells, epithelial cells and many types of tumor cells. In most of these tissues, inflammatory mediators, such as interleukin-1, interleukin-6, tumor necrosis factor or endotoxin, are potent inducers of GM-CSF gene expression, which occurs at least partly by post-transcriptional nabilization of the GM-CSF mRNA.

The GM-CSF is a glycoprotein of 127 aa sharing 63 to 70% sequence identity with canine, feline, porcine and rat and 54% with mouse GM-CSFs.

The biological effects of GM-CSF are mediated through binding to cell surface receptors, which appear to be widely expressed by thermatopoietic cells and also by some non-thermatopoietic cells, such as endothelial cells. At least two different functional classes of GM-CSF receptor have been identified. The neutrophil GM-CSF receptor exclusively binds GM-CSF, while interleukin-3 competes for binding of GM-CSF to a second class of receptors detected on some leukemic cell lines (7). Monitoring of GM-CSF has been found relevant in human prostate cancer (14), poorly healing wounds (8), thyroid carcinoma (12), severe mucositis (11), fungal infections (13), AIDS (17), bone marrow transplantation (19, 4, 2, 1), renal cell carcinoma and prostate cancer (18), acute lymphoblastic leukemia (15, 4) pulmoary inflammation (5), hematological malignancies (15, 9), infection (6), lung cancer (5).

Principle of the Method

A capture Antibody highly specific for GM-CSF has been coated to the wells of the microtiter strip plate provided during manufacture. Binding of GM-CSF in samples and known standards to the capture antibodies and subsequent binding of the biotinylated anti- GMCSF secondary antibody to the analyte is completed during the same incubation period. Any excess unbound analyte and secondary antibody is removed. The HRP conjugate solution is then added to every well including the zero wells, following incubation excess conjugate is removed by careful washing. A chromogen substrate is added to the

wells resulting in the progressive development of a blue coloured complex with the conjugate. The colour development is then stopped by the addition of acid turning the resultant final product yellow. The intensity of the produced coloured complex is directly proportional to the concentration of GM-CSF present in the samples and standards. The absorbance of the colour complex is then measured and the generated OD values for each standard are plotted against expected concentration forming a standard curve. This standard curve can then be used to accurately determine the concentration of GM-CSF in any sample tested.

Reagents provided and reconstitution

Reagents (Store@2-8°C)	Quantity 1x48 well kit Cat no.	Quantity 1x96 well kit Cat no.	Quantity 2x96 well kit Cat no.	Reconstitution
96 well microtiter strip plate	1/2	1	2	Ready to use (Pre-coated)
Plastic plate covers	2	2	4	n/a
Standard: 500pg/ml	1	2	4	Reconstitute as directed on the vial (see Assay preparation, section 8)
Standard Diluent (Buffer)	1 (25ml)	1 (25ml)	1 (25ml)	10x Concentrate, dilute in distilled water (see reagent preparation, section 8)
Biotinylated anti-GM-CSF	1 (0.4ml)	1 (0.4ml)	2 (0.4ml)	Dilute in Biotinylated Antibody Diluent (see Assay preparation, section 8)
Biotinylated Antibody Diluent	1 (7ml)	1 (7ml)	1 (13ml)	Ready to use
Streptavidin-HRP	1 (5ul)	2 (5ul)	4 (5ul)	Add 0.5ml of HRP diluent prior to use (see Assay preparation, section 8)
HRP Diluent	1 (23ml)	1 (23ml)	1 (23ml)	Ready to use
Wash Buffer	1 (10ml)	1 (10ml)	2 (10ml)	200x Concentrate dilute in distilled water (see Assay preparation, section 8)
TMB Substrate	1 (11ml)	1 (11ml)	1 (24ml)	Ready to use
H ₂ SO ₄ stop reagent	1 (11ml)	1 (11ml)	2 (11ml)	Ready to use

Materials required but not provided

- Microtiter plate reader fitted with appropriate filters (450nm required with optional 630nm reference filter)
- Microplate washer or wash bottle
- 10, 50, 100, 200 and 1,000µl adjustable single channel micropipettes with disposable tips
- 50-300ul multi-channel micropipette with disposable tips
- Multichannel micropipette reagent reservoirs
- Distilled water
- Vortex mixer

- Miscellaneous laboratory plastic and/or glass, if possible sterile

Storage Instructions

Store kit reagents between 2 and 8°C. Immediately after use remaining reagents should be returned to cold storage (2-8°C). Expiry of the kit and reagents is stated on box front labels. The expiry of the kit components can only be guaranteed if the components are stored properly, and if, in case of repeated use of one component, the reagent is not contaminated by the first handling.

Wash Buffer: Once prepared store at 2-8°C for up to 1 week

Standard Diluent Buffer: Once prepared store at 2-8°C for up to 1 week

Standards : Once prepared use immediately and do not store

Biotinylated Secondary Antibody: Once prepared use immediately and do not store

Streptavidin-HRP: Once prepared use immediately and do not store

Specimen collection, processing & storage

Cell culture supernatants, serum, plasma or other biological samples will be suitable for use in the assay.

Remove serum from the clot or red cells, respectively, as soon as possible after clotting and separation.

Cell culture supernatants: Remove particulates and aggregates by spinning at approximately 1000 x g for 10 min.

Serum: Avoid any unintentional stimulation of the cells by the procedure. Use pyrogen/endotoxin free collecting tubes. Serum should be removed rapidly and carefully from the red cells after clotting. For that, after clotting, centrifuge at approximately 1000 x g for 10 min and remove serum.

Plasma: EDTA, citrate and heparin plasma can be assayed. Spin samples at 1000 x g for 30 min to remove particulates. Harvest plasma.

Storage: If not analyzed shortly after collection, samples should be aliquoted (250-500µl) to avoid repeated freeze-thaw cycles and stored frozen at -70°C. Avoid multiple freeze-thaw cycles of frozen specimens.

Recommendation: Do not thaw by heating at 37°C or 56°C. Thaw at room temperature and make sure that sample is completely thawed and homogeneous before use. When possible avoid use of badly haemolysed or lipemic sera. If large amounts of particles are present these should be removed prior to use by centrifugation or filtration.

Safety & precautions for use

- Handling of reagents, serum or plasma specimens should be in accordance with local safety procedures, e.g. CDC/NIH Health manual : " Biosafety in Microbiological and Biomedical Laboratories" 1984

- Laboratory gloves should be worn at all times
- Avoid any skin contact with H₂SO₄ and TMB. In case of contact, wash thoroughly with water
- Do not eat, drink, smoke or apply cosmetics where kit reagents are used
- Do not pipette by mouth
- When not in use, kit components should be stored refrigerated or frozen as indicated on vials or bottles labels
- All reagents should be warmed to room temperature before use. Lyophilized standards should be discarded after use
- Once the desired number of strips has been removed, immediately reseal the bag to protect the remaining strips from deterioration
- Cover or cap all reagents when not in use
- Do not mix or interchange reagents between different lots
- Do not use reagents beyond the expiration date of the kit
- Use a clean disposable plastic pipette tip for each reagent, standard, or specimen addition in order to avoid cross contamination, for the dispensing of H₂SO₄ and substrate solution, avoid pipettes with metal parts
- Use a clean plastic container to prepare the washing solution
- Thoroughly mix the reagents and samples before use by agitation or swirling
- All residual washing liquid must be drained from the wells by efficient aspiration or by decantation followed by tapping the plate forcefully on absorbent paper. Never insert absorbent paper directly into the wells
- The TMB solution is light sensitive. Avoid prolonged exposure to light. Also, avoid contact of the TMB solution with metal to prevent colour development. Warning TMB is toxic avoid direct contact with hands. Dispose off properly
- If a dark blue colour develops within a few minutes after preparation, this indicates that the TMB solution has been contaminated and must be discarded. Read absorbance's within 1 hour after completion of the assay
- When pipetting reagents, maintain a consistent order of addition from well-to-well. This will ensure equal incubation times for all wells

- Follow incubation times described in the assay procedure
- Dispense the TMB solution within 15 min of the washing of the microtitre plate

Assay Preparation

Bring all reagents to room temperature before use

Assay Design

Determine the number of microwell strips required to test the desired number of samples plus appropriate number of wells needed for running zeros and standards. Each sample, standard and zero should be tested in duplicate. Remove sufficient Microwell Strips for testing from the pouch immediately prior to use. Return any wells not required for this assay with desiccant to the pouch. Seal tightly and return to 2-8°C storage.

Example plate layout (example shown for a 6 point standard curve)

	Standards (pg/mL)		Sample Wells									
	1	2	3	4	5	6	7	8	9	10	11	12
A	500	500										
B	250	250										
C	125	125										
D	62.5	62.5										
E	31.25	31.25										
F	15.6	15.6										
G	zero	zero										
H												

All remaining empty wells can be used to test samples in duplicate

Preparation of Wash Buffer

Dilute the (200x) wash buffer concentrate 200 fold with distilled water to give a 1x working solution. Pour entire contents (10 ml) of the Washing Buffer Concentrate into a clean 2,000 ml graduated cylinder. Bring final volume to 2,000 ml with glass-distilled or deionized water. Mix gently to avoid foaming. Transfer to a clean wash bottle and store at 2°-8°C for up to 1 week.

Preparation of Standard Diluent Buffer

Add the contents of the vial (10x concentrate) to 225ml of distilled water before use.

This solution can be stored at 2-8°C for up to 1 week.

Preparation of Standard

Standard vials must be reconstituted with the volume of standard diluent shown on the vial immediately prior to use. This reconstitution gives a stock solution of 500 pg/ml of GM-CSF. Mix the reconstituted standard gently by inversion only. Serial dilutions of the standard are made directly in the assay plate to provide the concentration range from 500 to 15.6 pg/ml. A fresh standard curve should be produced for each new assay.

- Immediately after reconstitution add 200ul of the reconstituted standard to wells A1 and A2, which provides the highest concentration standard at 500 pg/ml
- Add 100ul of Standard Diluent to the remaining standard wells B1 and B2 to F1 and F2
- Transfer 100ul from wells A1 and A2 to B1 and B2. Mix the well contents by repeated aspirations and ejections taking care not to scratch the inner surface of the wells
- Continue this 1:1 dilution using 100ul from wells B1 and B2 through to wells F1 and F2 providing a serial diluted standard curve ranging from 500 pg/ml to 15.6 pg/ml
- Discard 100ul from the final wells of the standard curve (F1 and F2)

Alternatively these dilutions can be performed in separate clean tubes and immediately transferred directly into the relevant wells.

Preparation of Samples

Before testing, human serum or plasma samples have to be diluted 1:2 in Standard Buffer Diluent.

Preparation of Biotinylated anti-GM-CSF

It is recommended this reagent is prepared immediately before use. Dilute the biotinylated anti-GM-CSF with the biotinylated antibody diluent in an appropriate clean glass vial using volumes appropriate to the number of required wells. Please see example volumes below:

Number of wells required	Biotinylated Antibody (ul)	Biotinylated Antibody Diluent (ul)
16	40	1060
24	60	1590
32	80	2120
48	120	3180
96	240	6360

Preparation of Streptavidin-HRP

It is recommended to centrifuge vial for a few seconds in a microcentrifuge to collect all the volume at the bottom.

Dilute the 5ul vial with 0.5ml of HRP diluent immediately before use. experiments. Further dilute the HRP solution to volumes appropriate clean glass vial. Please see example volumes below:

Do-not keep this diluted vial for future for the number of required wells in a

Number of wells required	Streptavidin-HRP (ul)	Streptavidin-HRP Diluent (ml)
16	30	2
24	45	3
32	60	4
48	75	5
96	150	10

Method

We strongly recommend that every vial is mixed thoroughly without foaming prior to use except the standard vial which must be mixed gently by inversion only.

Prepare all reagents as shown in section 8.

Note: Final preparation of Biotinylated anti-GM-CSF (section 8.6) and Streptavidin-HRP (section 8.7) should occur immediately before use.

Assay Step		Details
1.	Addition	Prepare Standard curve as shown in section 8.4
2.	Addition	Add 100µl of each standard, diluted sample and zero in duplicate to appropriate number of wells
3.	Addition	Add 50µl of diluted biotinylated anti-GM-CSF to all wells
4.	Incubation	Cover with a plastic plate cover and incubate at room temperature (18 to 25°C) for 3 hours
5.	Wash	Remove the cover and wash the plate as follows: a) Aspirate the liquid from each well b) Dispense 0.3 ml of 1x washing solution into each well c) Aspirate the contents of each well d) Repeat step b and c another two times
6.	Addition	Add 100µl of Streptavidin-HRP solution into all wells
7.	Incubation	Cover with a plastic plate cover and incubate at room temperature (18 to 25°C) for 30 min
8.	Wash	Repeat wash step 4.
9.	Addition	Add 100µl of ready-to-use TMB Substrate Solution into all wells
10.	Incubation	Incubate in the dark for 10-20 minutes* at room temperature. Avoid direct exposure to light by wrapping the plate in aluminium foil.
11.	Addition	Add 100µl of H₂SO₄:Stop Reagent into all wells

Read the absorbance value of each well (immediately after step 13.) on a spectrophotometer using 450 nm as the primary wavelength and optionally 630 nm as the reference wave length (610 nm to 650 nm is acceptable).

*Incubation time of the substrate solution is usually determined by the ELISA reader performance. Many ELISA readers only record absorbance up to 2.0 O.D. Therefore the colour development within individual microwells must be observed by the analyst, and the substrate reaction stopped before positive wells are no longer within recordable range

Data Analysis

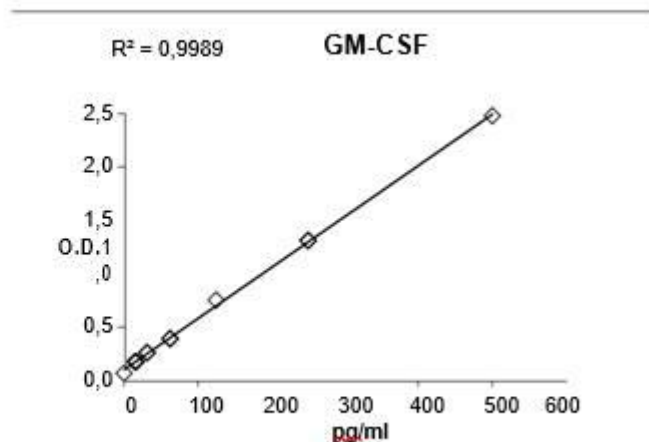
Calculate the average absorbance values for each set of duplicate standards and samples. Ideally duplicates should be within 20% of the mean.

Generate a linear standard curve by plotting the average absorbance of each standard on the vertical axis versus the corresponding Human GM-CSF standard concentration on the horizontal axis.

The amount of GM-CSF in each sample is determined by extrapolating OD values against GM-CSF standard concentrations using the standard curve.

Example GM-CSF Standard curve

Standard	GM-CSF Conc	OD (450nm) mean	CV (%)
1	500	2.480	2,3
2	250	1.312	4,2
3	125	0.755	6,4
4	62,5	0.391	2,5
5	31,25	0.257	6,3
6	15,6	0.173	4,1
Zero	0	0.067	-



Note: curve shown above should not be used to determine results. Every laboratory must produce a standard curve for each set of microwell strips assayed.

For samples human serum or plasmas which have been diluted 1:2 according to the protocol, the calculated concentration should be multiplied by the dilution factor (x2)

Assay limitations

Do not extrapolate the standard curve beyond the maximum standard curve point. The dose-response is non-linear in this region and good accuracy is difficult to obtain. Concentrated samples above the maximum standard concentration must be diluted with Standard diluent or with your own sample buffer to produce an OD value within the range of the standard curve. Following analysis of such samples always multiply results by the appropriate dilution factor to produce actual final concentration.

The influence of various drugs on end results has not been investigated. Bacterial or fungal contamination and laboratory cross-contamination may also cause irregular results.

Improper or insufficient washing at any stage of the procedure will result in either false positive or false negative results. Completely empty wells before dispensing fresh Washing Buffer, fill with Washing Buffer as indicated for each wash cycle and do not allow wells to sit uncovered or dry for extended periods.

Disposable pipette tips, flasks or glassware are preferred, reusable glassware must be washed and thoroughly rinsed of all detergents before use.

As with most biological assays conditions may vary from assay to assay therefore a fresh standard curve must be prepared and run for every assay.

Performance Characteristics

Sensitivity

The sensitivity, minimum detectable dose of GM-CSF using this Biorbyt GM-CSF ELISA kit was found to be <4.8pg/ml. This was determined by adding 2 standard deviations to the mean OD obtained when the zero standard was assayed 40 times.

Precision

Intra-assay

Reproducibility within the assay was evaluated in three independent experiments. Each assay was carried out with 6 replicates (3 duplicates) in 2 human pooled serum, 2 in culture media and 2 in standard diluent with samples containing different concentrations of GM-CSF. 2 standard curves were run on each plate The overall intra-assay coefficient of variation has been calculated to be 3.7%.

Session	Sample	Mean GM-CSF pg/ml	SD	CV%
Session 1	Sample 1	581.43	14.98	2.5
	Sample 2	388.53	10.80	2.8
	Sample 3	529.93	22.36	4.2
	Sample 4	336.45	12.74	3.8
	Sample 5	208.03	12.85	6.2
	Sample 6	84.07	1.92	2.3
Session 2	Sample 1	514.21	39.19	7.6
	Sample 2	340.15	11.2	3.3
	Sample 3	471.60	25.98	5.5
	Sample 4	288.01	12.72	4.4
	Sample 5	206.78	5.04	2.4
	Sample 6	63.11	1.59	2.5
Session 3	Sample 1	533.37	3.34	0.6
	Sample 2	339.61	8.5	2.5
	Sample 3	500.43	22.79	4.6
	Sample 4	322.49	10.68	3.3
	Sample 5	144.38	2.01	1.4
	Sample 6	67.22	4.5	6.7

Inter-assay

Assay to assay reproducibility within one laboratory was evaluated in three independent experiments by two technicians. Each assay was carried out with 6 replicates (3 duplicates) in 2 human pooled serum, 2 in culture media and 2 in standard diluent with samples containing different concentrations of GM-CSF. 2 standard curves were run on each plate. The calculated overall coefficient of variation was 6.6%.

	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
Mean GM-CSF pg/ml	518	327	459	293	184	74
SD	28	34	49	26	3	2
CV	5.5	10.5	10.6	9.0	1.9	2.3

Dilution Parallelism

Two spiked human serum with different levels of recombinant GM-CSF were analysed at three serial two fold dilutions (1:2-1:8) with two replicates each. Recoveries ranged from 89% to 136% with an overall mean recovery of 109%.

Spike Recovery

The spike recovery was evaluated by spiking two concentrations of recombinant GM-CSF in human serum and culture media in three experiments. Recoveries ranged from 98% to 148% with an overall mean recovery of 119%.

Specificity

The assay recognizes natural human GM-CSF. To define specificity of this ELISA, several proteins were tested for cross reactivity. There was no cross reactivity observed for any protein tested (IL-1 α , IL-1 β , IL-2, IL-4, IL-5, IL-6, IL-8, IL-10, IFN γ , TNF α).

Stability

Storage Stability

Aliquots of spiked serum sample and culture media were stored at -20°C , $2-8^{\circ}\text{C}$, room temperature (RT) and at 37°C and the GM-CSF level determined after 24h. No significant loss is observed.

Freeze-thaw Stability

Aliquots of spiked serum and culture media were stored frozen at -20°C and thawed up to 5 times and GM-CSF level was determined. There was no significant loss of GM-CSF reactivity during storage.

Expected serum values

A panel of 20 sera and 20 plasmas coming from apparently healthy blood donors was tested for GM-CSF.

All were below the detection level $<4.8\text{pg/ml}$.

Standard Calibration

This immunoassay is calibrated against the International Reference Standard NIBSC 88/646. NIBSC 88/646 is quantitated in International Units (IU). 1IU corresponding to 120pg Biorbyt GM-CSF.

Bibliography

- 1) Antman KH. GM-CSF in marrow transplantation. *Eur J Cancer*. 1993;29A Suppl 3:S2-6. Review.
- 2) Bolwell BJ. The use of G-CSF and GM-CSF in bone marrow transplantation. *Cleve Clin J Med*. 1993 Jul-Aug;60(4):291-302. Review.
- 3) Burgess AW, Metcalf D. The nature and action of granulocyte-macrophage colony stimulating factors. *Blood* 1980 Dec;56(6):947-58
- 4) Croockewit S. GM-CSF in haematopoietic stem cell transplantation. *Eur J Cancer*. 1999 Aug;35 Suppl 3:S11-3. Review. No abstract available.
- 5) Drings P, Fischer JR. Biology and clinical use of GM-CSF in lung cancer. *Lung*. 1990;168 Suppl:1059-68. Review.
- 6) Freund M, Kleine HD. The role of GM-CSF in infection. *Infection*. 1992;20 Suppl 2:S84-92 Review.
- 7) Griffin JD, Cannistra SA, Sullivan R, Demetri GD, Ernst TJ, Kanakura Y. The biology of GM-CSF: regulation of production and interaction with its receptor. *Int J Cell Cloning* 1990 Jan;8 Suppl 1:35-44; discussion 44-5.
- 8) Groves RW, Schmidt-Lucke JA. Recombinant human GM-CSF in the treatment of poorly healing wounds. *Adv Skin Wound Care*. 2000 May-Jun;13(3 Pt 1):107-12. Review.
- 9) Harmenberg J, Hoglund M, Hellstrom-Lindberg E. G- and GM-CSF in oncology and oncological haematology. *Eur J Haematol Suppl*. 1994;55:1-28. Review.
- 10) Harousseau JL, Wu D. The use of GM-CSF and G-CSF in the treatment of acute leukemias. *Leuk Lymphoma*. 1995 Aug;18(5-6):405-12. Review.
- 11) Hejna M, Brodowicz T, Zielinski CC. Local use of GM-CSF for severe mucositis. *Eur J Cancer*. 1999 Aug;35 Suppl 3:S14-7. Review. No abstract available.
- 12) Hoshi S, Yoshizawa A, Arioka H, Kobayashi N, Kudo K, Niino H. Anaplastic thyroid carcinoma with lung metastasis producing CA 19-9 and GM-CSF. *Nihon Kogyuki Gakkai Zasshi*. 2000 May;38(5):391-7. Review. Japanese.
- 13) Jones TC. Use of granulocyte-macrophage colony stimulating factor (GM-CSF) in prevention and treatment of fungal infections. *Eur J Cancer*. 1999 Aug;35 Suppl 3:S8-10. Review. No abstract available.

- 14) Lim M, Simons JW. Emerging concepts in GM-CSF gene-transduced tumor vaccines for human prostate cancer. *Curr Opin Mol Ther.* 1999 Feb;1(1):64-71. Review. No abstract available.
- 15) Lowenberg B, de Greef GE, Wielenga JJ. Granulocyte-macrophage colony stimulating factor (GM-CSF) in the treatment of hermatological malignancies. *Anticancer Drugs.* 1993 May;4 Suppl 1:17-20. Review.
- 16) Ottmann OG, Hoelzer D. Do G-CSF and GM-CSF contribute to the management of acute lymphoblastic leukemia? *Leukemia.* 1996 Jul;10(7):1111-6. Review. No abstract available.
- 17) Ross SD, DiGeorge A, Connelly JE, Whiting GW, McDonnell N. Safety of GM-CSF in patients with AIDS: a review of the literature. *Pharmacotherapy.* 1998 Nov-Dec;18(6):1290-7 Review.
- 18) Simons JW. Bioactivity of human GM-CSF gene therapy in metastatic renal cell carcinoma and prostate cancer. *Hinyokika Kiyo.* 1997 Nov;43(11):821-2. Review. No abstract available.
- 19) Toren A, Nagler A. The implications of granulocyte-monocyte colony-stimulating factor (GM-CSF) in cytotoxicity of bone marrow transplantation. *Cytokines Cell Mol Ther.* 1998 Sep;4(3):199-206. Review.
- 20) Xing Z, Braciak T, Ohkawara Y, Sallenave JM, Foley R, Sime PJ, Jordana M, Graham FL, Gauldie J. Gene transfer for cytokine functional studies in the lung: the multifunctional role of GM-CSF in pulmonary inflammation. *J Leukoc Biol.* 1996 Apr;59(4):481-8. Review.

Assay Summary

Total procedure length: 3h45mn

Add 100 ul of diluted standard and 100µl of sample, and 50 ul Biotinylated anti- GM-CSF



Incubate 3 hours at room temperature



Wash three times



Add 100µl of Streptavidin-HRP



Incubate 30min at room temperature



Wash three times



Add 100 µl of ready-to-use TMB

Protect from light. Let the color develop for 10-20 mn.



Add 100 H2SO4



Read Absorbance at 450 nm