VIDEO DROP

Insights from Publications

myriade

VIDEO DROP SC Designed by physicists, for biologists

Videodrop is an advanced combination of optical innovation from the Langevin Institute and high-performance software algorithms. It provides the easiest and fastest way to measure nanoparticle size and concentration. Based on Interferometric Light Microscopy (ILM), Videodrop is the ideal tool for scientists working on lentiviral vector (LV) development, extracellular vesicle (EVs) research and production, and lipid nanoparticle (LNP) formulation.

APPLICATIONS

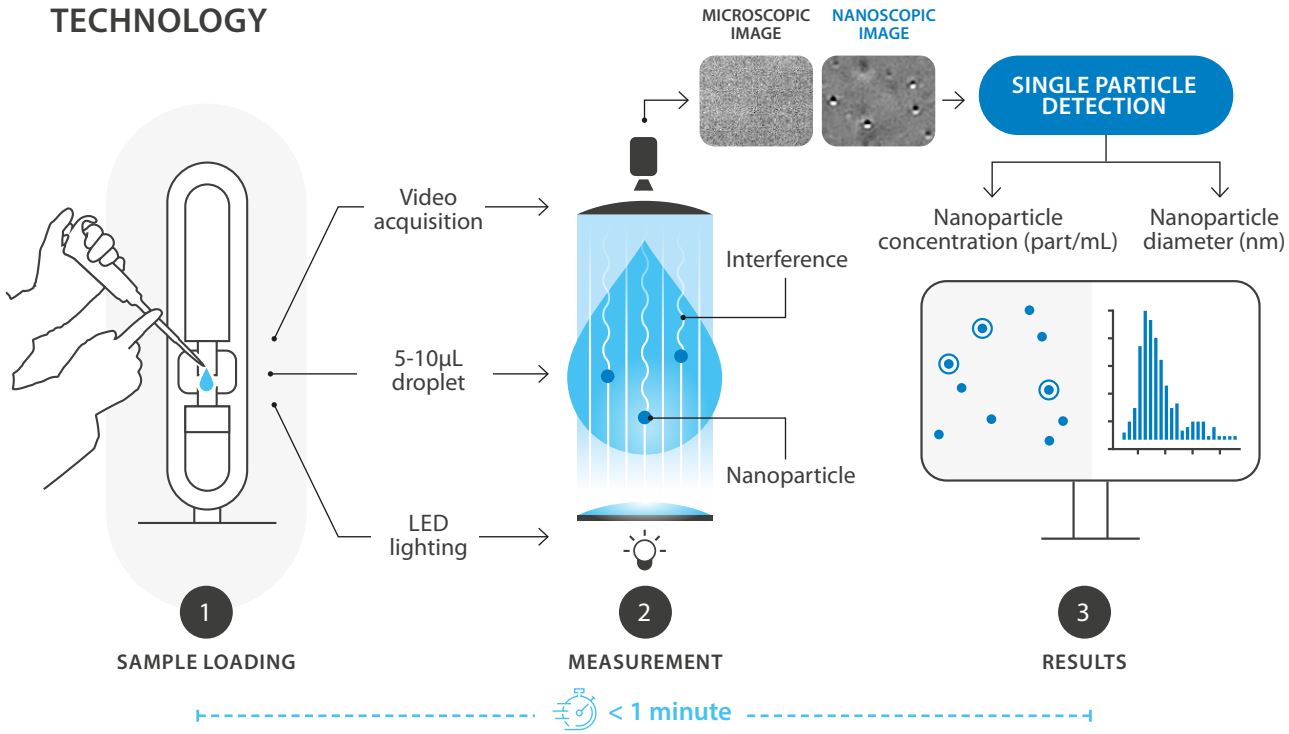
LV · EVs · LNP · Phages

SPECIFICITIES

5-10µL	80-500nm	10^8-10^{10} part/mL	UP TO 10µm
In a single drop	Size range	Concentration range	Visualization

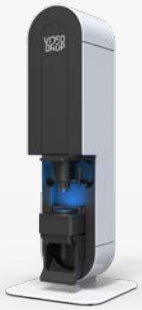
21CFR part 11 compliant · No labelling & non denaturant · Complex & viscous sample

TECHNOLOGY



Interferometric Light Microscopy (ILM) in 3 steps

The innovative idea of the scientific team is to have **transformed a standard microscope into an interferometer.** The nanoparticle solution is illuminated by a simple LED. A high dynamic range camera & images processing algorithms make it possible **to detect and track the interferences patterns** between the light scattered by the nanoparticles and the incident light signal. **The single particle detection** allows for accurate measurement of heterogeneous samples.



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Assess EV Biomarkers in longitudinal clinical studies

Extracellular vesicles (EVs) are emerging as circulating biomarkers for various diseases and indicators of therapeutic response. Therefore, a systemic standardization to better assess the concentration of EVs is highly required.

HOW CAN VIDEODROP ENHANCE YOUR RESEARCH?

- Perform comprehensive analysis of large patient biological sample cohorts.
- Achieve repeatable, reproducible, and operator-bias-free results in longitudinal studies.

PUBLICATION ONLINE

Monitoring concentration and lipid signature of plasma extracellular vesicles from HR+ metastatic breast cancer patients under CDK4/6 inhibitors treatment, M. Richard et al., J. Ex. Bio. 2024

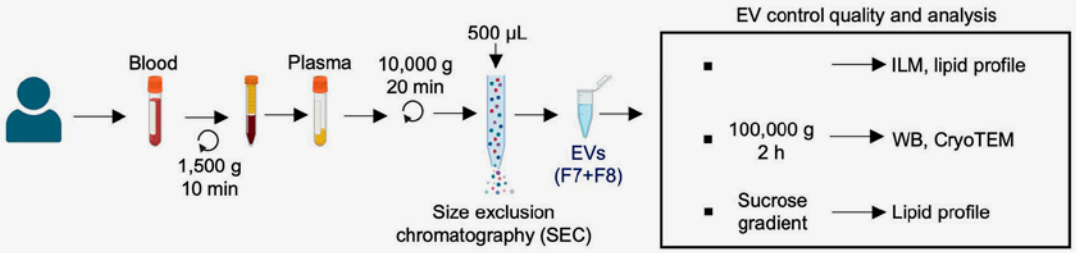


Fig: Plasma-derived EV enrichment protocol

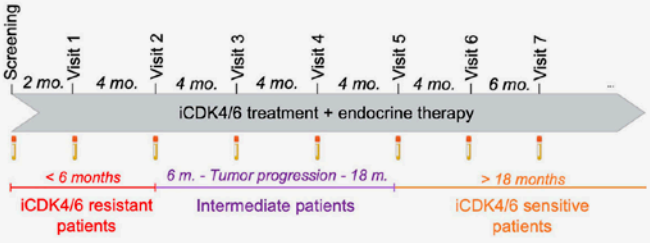


Fig: Timeline of sample collection associated with the clinical status of MBC (Metastatic Breast Cancer) patients from EPICURE cohort

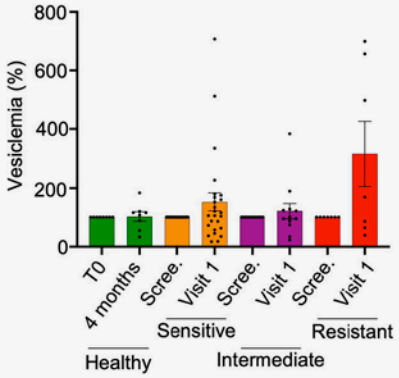


Fig: Histogram showing vesiclemia (in percent, normalize to screening time) at T0 (screening) and 2 months in healthy subjects (n=8), sensitive (n=25), intermediate and resistant (n= 7)

In this longitudinal clinical study involving healthy individuals and patients with metastatic breast cancer, Videodrop was utilized to measure "vesiclemia" (the concentration of EVs in plasma). Its rapid measurement capability enabled high-throughput analysis of numerous samples at each timepoint.

The von Willebrand factor stamps plasmatic extracellular vesicles from glioblastoma patients, Q. Sabbagh et al., Scientific Reports 2021

PUBLICATION ONLINE

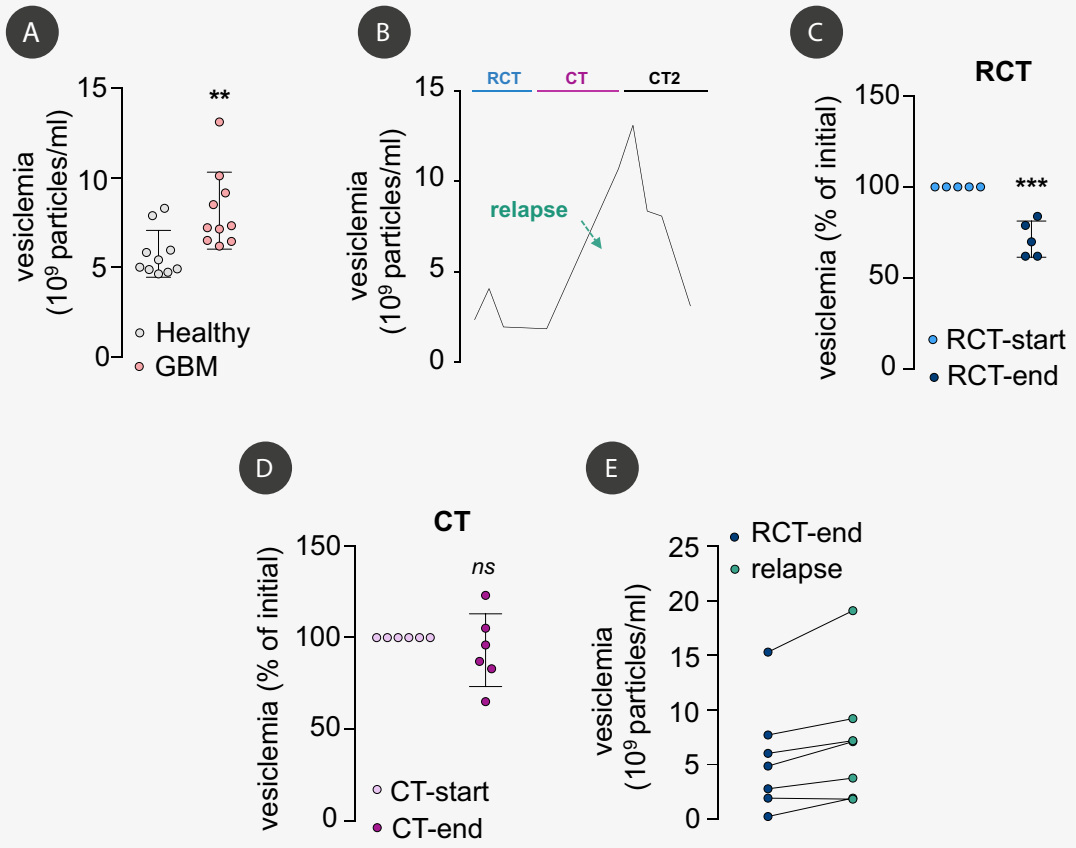


Fig: Vesiclemia evolves along glioblastoma progression.
(A) Vesiclemia (number of particles/ml) was measured by interferometry light microscope (ILM) in healthy donors and GBM patients (n = 10 in each group). **(B,C,D,E)** Vesiclemia was measured in longitudinal samples from several GBM patients, in order to assess the impact of radio-chemotherapy (RCT) (n = 5) **(C)**, chemotherapy (CT) (n = 6) **(D)**, and relapse (n = 7) **(E)**. Mann–Whitney test, *p < 0.05, **p < 0.01, ***p < 0.001. S.E.M. are shown in panels **A, C,** and **D**.

In this publication, vesiclemia was tracked in the plasma of glioblastoma patients during a longitudinal study. Videodrop was employed to assess treatment responses (radiotherapy and chemotherapy).

Evaluate *in vivo* and *in vitro* EV response to therapeutic procedures

Circulating extracellular vesicles (EVs) are implicated in a wide range of physiological processes and disease mechanisms. Characterizing EVs from in vivo and in vitro models is essential for studying pathogenesis and assessing disease responses to therapeutic procedures

HOW CAN VIDEODROP ENHANCE YOUR RESEARCH?

- Monitor EVs isolation process from *in vivo* and *in vitro* models
- Assess disease response to therapeutic procedures

PUBLICATION ONLINE

Isolating plasma extracellular vesicles from mouse blood using size-exclusion chromatography, density gradient, and ultracentrifugation,
G. André-Grégoire et al., STAR Protocols 2023

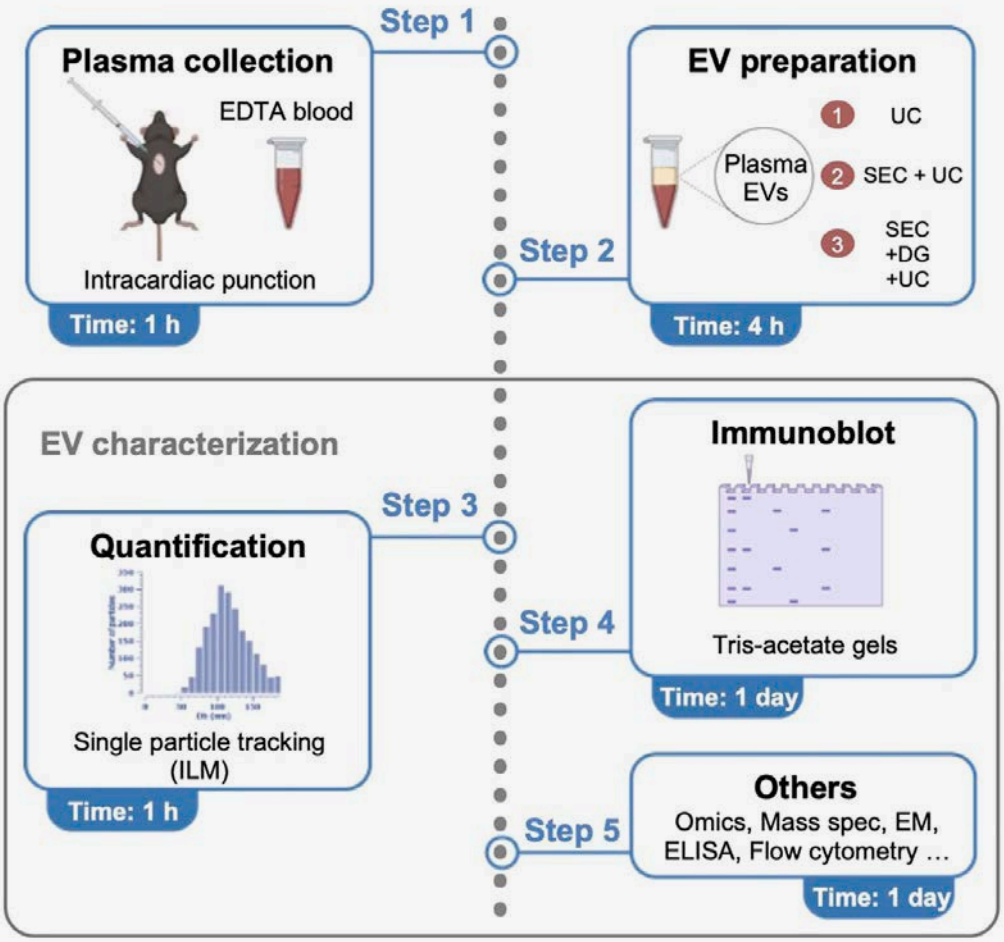
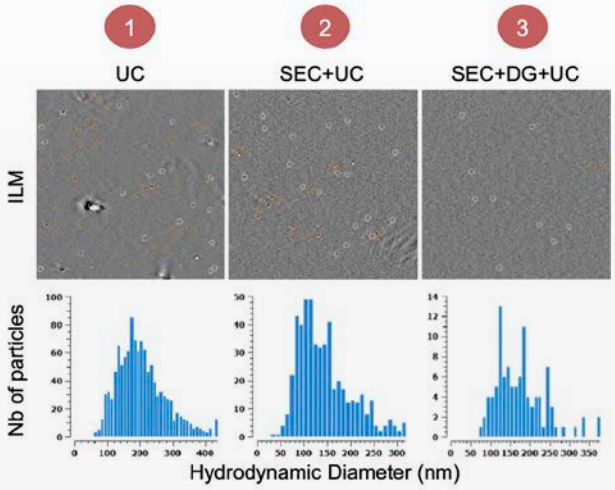


Fig: Circulating EVs isolation and characterization protocol



Concentration (particles/mL) :	2.68e+9	1.34e+9	3.33e+8
Median diameter (nm) :	197	197	170
Tracked particles :	1167	531	104

Fig: 4-year-old frozen plasma from three mice bearing human GSC-derived orthotopic tumors1 was thawed on ice and pooled to a final volume of 1500 mL. […] EVs were obtained by (1) differential ultracentrifugation (UC), (2) size exclusion chromatography combined with UC (SEC+UC), or (3) SEC combined with density gradient and UC (SEC+DG+UC). Pelleted EVs were resuspended in 100 µL of cold particle-free PBS. 7 µL of each fresh EV preparation was used to measure the particle concentration and size distribution by interferometry light microscope (ILM, Videodrop, Myriade).

In this protocol, the Videodrop was systematically employed for the characterization of both size distribution and concentration of plasma EVs from murine models. Additionally, it also served as an in-process control for EV enrichment and isolation, paving the way for subsequent analyses using molecular biology, cytometry, or omics techniques.

Inhibition of the pseudokinase MLKL alters extracellular vesicle release and reduces tumor growth in glioblastoma, G. André-Grégoire et al., iScience 2022

PUBLICATION ONLINE

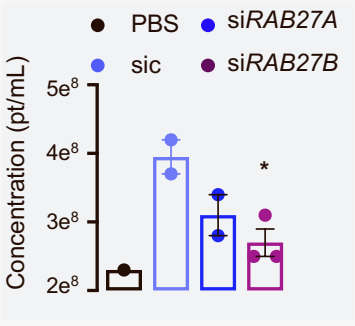


Fig: Glioblastoma Stem-like Cells were transfected with silencing RAB27A and RAB27B targeting RNA duplexes. This graph shows concentration of EVs that were isolated from the conditioned media 48h post-transfection.

In this study, Videodrop was used to assess the inhibition of EV release in an in vitro glioblastoma model. Videodrop's high throughput and low sample volume requirements enabled the monitoring of cell culture responses in the context of drug screening.

Real-time monitoring of virus purification

In biotechnology, viruses are employed to combat cancer (such as lentiviruses in CAR-T cell therapy) and tackle antibiotic resistance (using bacteriophages). When used as therapeutic agents, real-time monitoring of virus bioproduction is essential.

HOW CAN VIDEODROP ENHANCE YOUR RESEARCH?

- Enable real-time in-process control of downstream processing (DSP) efficiency
- Reduce quality control (QC) time for virus and phage purification

PUBLICATION ONLINE

Experimental Evaluation of an Interferometric Light Microscopy Particle Counter for Titering and Characterization of Virus Preparations, V. Turkki et al., Viruses 2021

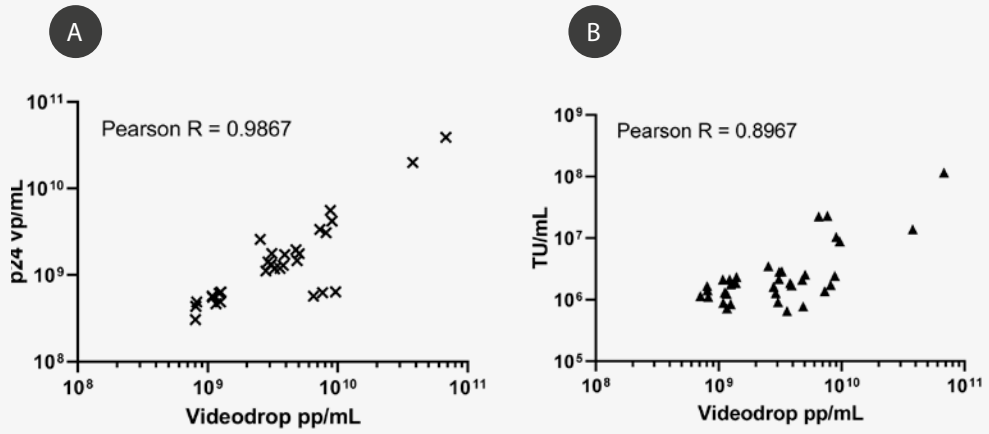


Fig: Videodrop LV assay results: **(A)** Correlation between the Videodrop measurement and vp/mL p24 ELISA result. **(B)** Correlation between the Videodrop measurement and TU/mL qPCR result.

Here, Videodrop was used to monitor lentivirus titer during batch purification. Its rapid measurement time allowed for real-time tracking of the downstream process, simultaneously serving as a viral titer predictor (showing high correlation with p24 ELISA and RT-qPCR).

Real-time monitoring by interferometric light microscopy of phage suspensions for personalised phage therapy, B. Lapras et al., Sci Rep 2024

PUBLICATION ONLINE

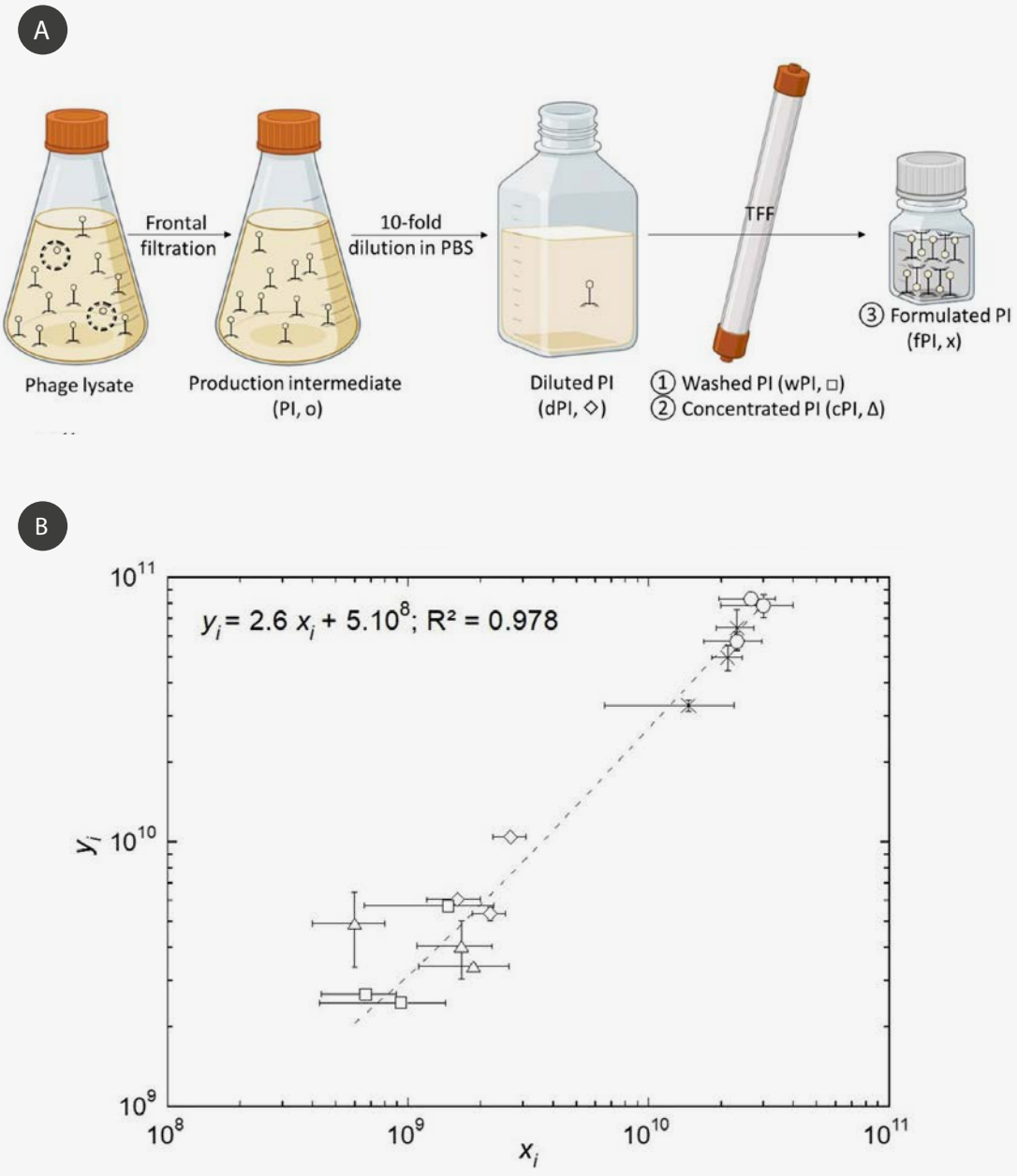


Fig: (A) Purification process flowchart. The phage lysate undergoes a frontal filtration, forming a production intermediate (PI), which is then tenfold diluted in PBS, forming a diluted PI (dPI), which enters tangential flow filtration (TFF) where the phage suspension is washed (wPI), then 10-time concentrated (cPI) and finally formulated (fPI) in PBS. **(B)** Particle concentration (y_i) as a function of phage infectious titre (x_i) during three replicates of purifications: (o) production intermediate, PI; (◊) diluted PI, dPI; (□) washed PI, wPI; (Δ) concentrated PI, cPI; (x) formulated PI, fPI.

Here, the Videodrop was used as an in-process quality control for anti-Staphylococcus aureus myovirus phage production. In addition to its correlation with phage infectious titer and easiness to use, ILM was also found to be the best method to detect aggregates within phage suspension (a criterion for product quality).

Control production of LNP & Nanocarriers for nucleic acid delivery

Nucleic acid delivery has seen unprecedented applications, ranging from vaccination to cell and gene therapy. The increasing use of lipid nanoparticles, liposomes, and other nanocomplexes for therapeutic purposes necessitates the development of new analytical strategies.

HOW CAN VIDEODROP ENHANCE YOUR RESEARCH?

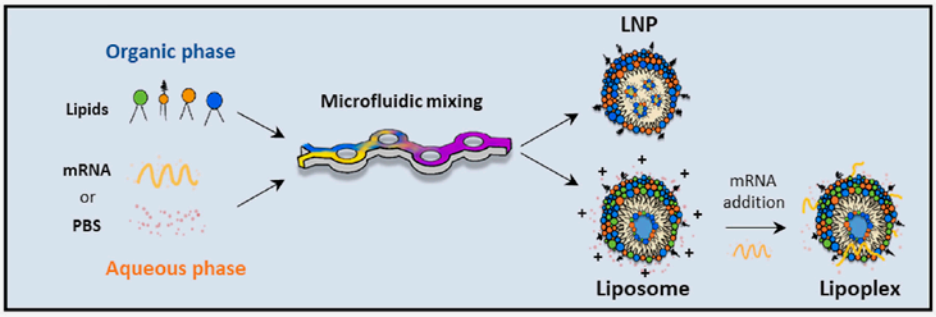
- Monitor the output of LNP/Liposome generation
- Assess product stability during storage
- Control product particle concentration before injection

PUBLICATION ONLINE

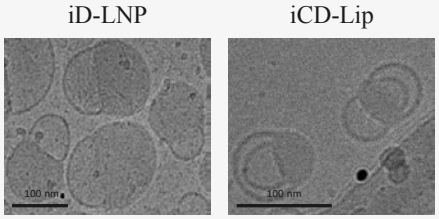
Enhancing natural killer cells proliferation and cytotoxicity using imidazole-based lipid nanoparticles encapsulating interleukin-2 mRNA,

C. Delehedde et al., Mol. Ther. Nucleic Acids 2024

A



B



C

Formulation	N/P ratio	Lipid molar concentration (mM)	Lipid mass concentration (mg/ mL)	Particles concentration (particles/ mL)	Number of particles in transfecting volume
iD-LNP	20	8.23	5	1.93×10^{12}	1.93×10^{10}
iCD-Lip	1	21.6	13.41	3.5×10^{12}	1.31×10^{9}

Fig: (A) Microfluidic formulation process of LNPs and liposomes, with handmade addition of mRNA to liposome leading to lipoplexes. **(B)** Morphological observations of iCD-Lip and iD-LNP by cryo-electron microscopy (Cryo-EM). **(C)** Difference in the lipid and particle concentration of iD-LNP and iCD-Lx as measured by Videodrop analysis, with calculated number of nanoparticles in the transfection conditions (for 0.5 µg of mRNA).

Here, the LNP concentration, as measured by Videodrop, was used to normalize cell-based assays (e.g., transfection activity) based on the number of nanoparticles. This novel approach, utilizing particle concentration, enables efficient comparative studies of LNPs.

Combining antimiR-25 and cGAMP Nanocomplexes Enhances Immune Responses via M2 Macrophage Reprogramming, M. Petrovic et al., Int J Mol Sci 2024

PUBLICATION ONLINE

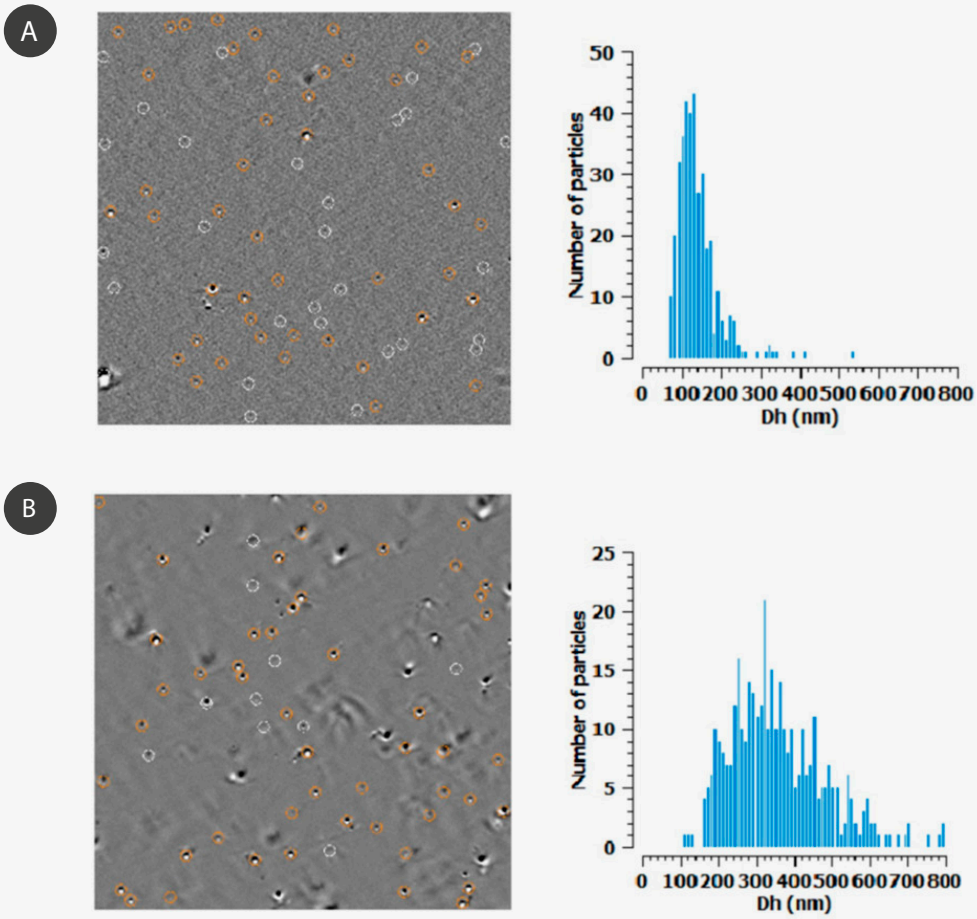


Fig. The antimiR-25 NCs' interactions with transferrin. The Videodrop image capture and graphical representation of antimiR-25 NCs **(A)** and antimiR-25 NCs mixed with 0.28 mg/mL human holo-transferrin (HTF) **(B)**

In this publication, Videodrop was used to confirm the interaction between nanocomplexes and protein. The Videodrop single-particle detection technique allows for an accurate nanoparticles size measurement.

Characterize nanoparticles in viscous samples

Characterizing nanoparticles (e.g., EVs, LNPs, nanocrystals) in viscous pharmaceutical formulations remains challenging due to the difficulty in effectively utilizing standard detection technologies like flow cytometry or NTA.

HOW CAN VIDEODROP ENHANCE YOUR RESEARCH?

- Investigate formulation viscosity
- Analyze particles within characterized viscous formulations

PUBLICATION ONLINE

Investigating Extracellular Vesicles in Viscous Formulations: Interplay of Nanoparticle Tracking and Nanorheology via Interferometric Light Microscopy, L. Alexandre et al., Small Sci. 2024

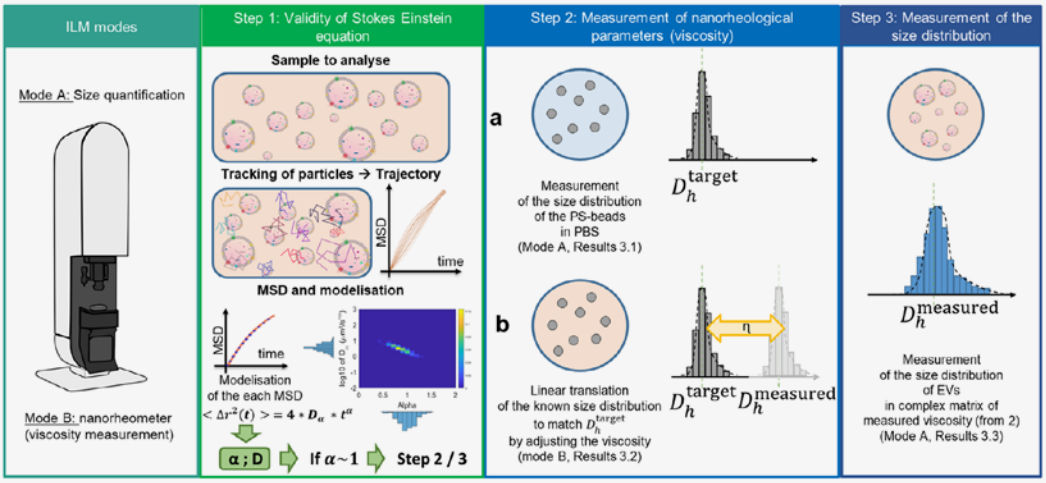


Fig : Description of the experimental workflow

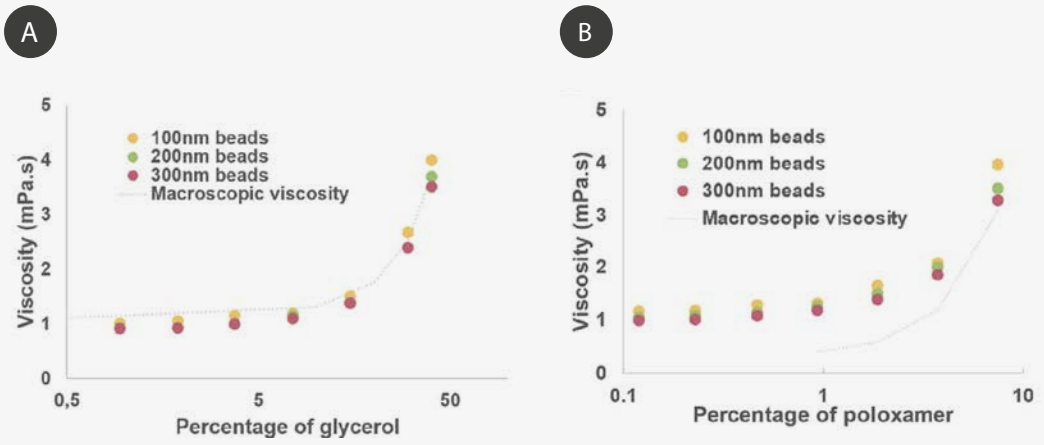


Fig: Mean local viscosity in different concentrations of glycerol **(A)** and poloxamer407 **(B)** probed by the beads of 100/200/300nm-diameter beads and comparison to the macroscopic viscosity measured with a clone-plate rheometer.

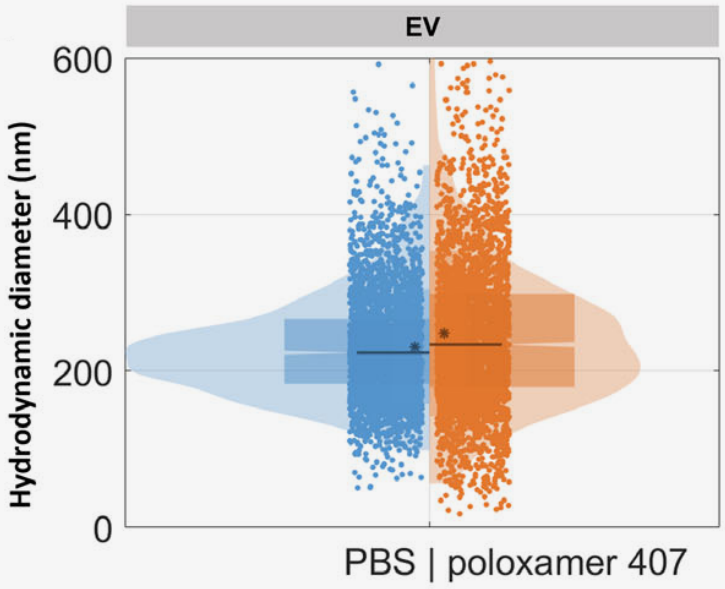


Fig: Display of the size distribution of EVs measured by ILM on PBS (blue) and 7.5% poloxamer 407 (orange).

Here, a straightforward approach was introduced for the study of nanoparticles within viscous Newtonian and non-Newtonian complex fluids. This innovative methodology establishes Videodrop as an essential tool for the characterization of nanoparticles in pharmaceutical formulations, including those formulated as hydrogels or highly viscous fluids.

Study raw samples

Studying extracellular vesicles (EVs) from complex samples like plasma, urine, other bodily fluids, and cell cultures presents several challenges, particularly concerning the reproducibility of their isolation and extraction. One strategy to minimize this variability is to bypass the isolation step and directly analyze raw samples.

HOW CAN VIDEODROP ENHANCE YOUR RESEARCH?

- Analyse raw biological samples without isolation/purification

PUBLICATION ONLINE

Assessment of Extracellular Particles Directly in Diluted Plasma and Blood by Interferometric Light Microscopy. A Study of 613 Human and 163 Canine Samples, B. Korenjak et al., Cells 2024

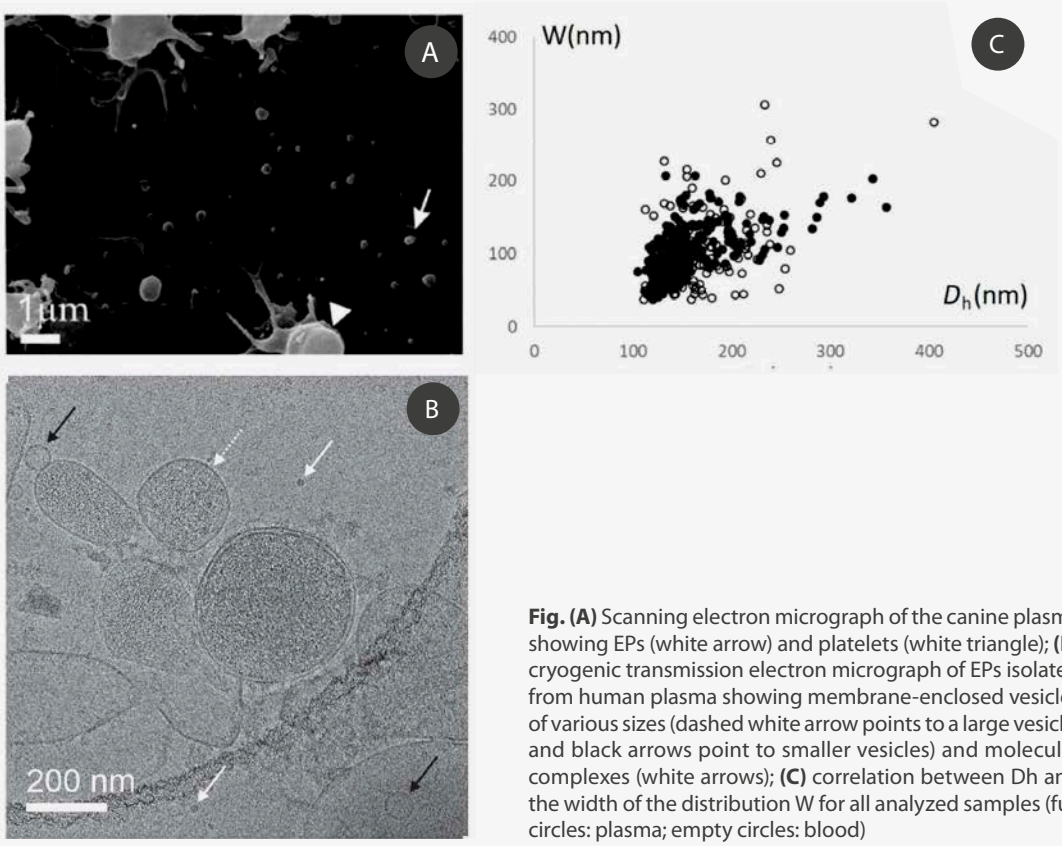


Fig. (A) Scanning electron micrograph of the canine plasma showing EPs (white arrow) and platelets (white triangle); **(B)** cryogenic transmission electron micrograph of EPs isolated from human plasma showing membrane-enclosed vesicles of various sizes (dashed white arrow points to a large vesicle, and black arrows point to smaller vesicles) and molecular complexes (white arrows); **(C)** correlation between Dh and the width of the distribution W for all analyzed samples (full circles: plasma; empty circles: blood)

Here, Videodrop was used to assess nanoparticle size distribution in raw blood and plasma samples, bypassing any EV purification step to minimize processing artifacts.

Short Term Effect of Plant Hybridosomes on Growth of Phaeo-dactylum Tricornutum Culture, A. Romolo et al., Proc. of Soc. Lec. 2023

PUBLICATION ONLINE

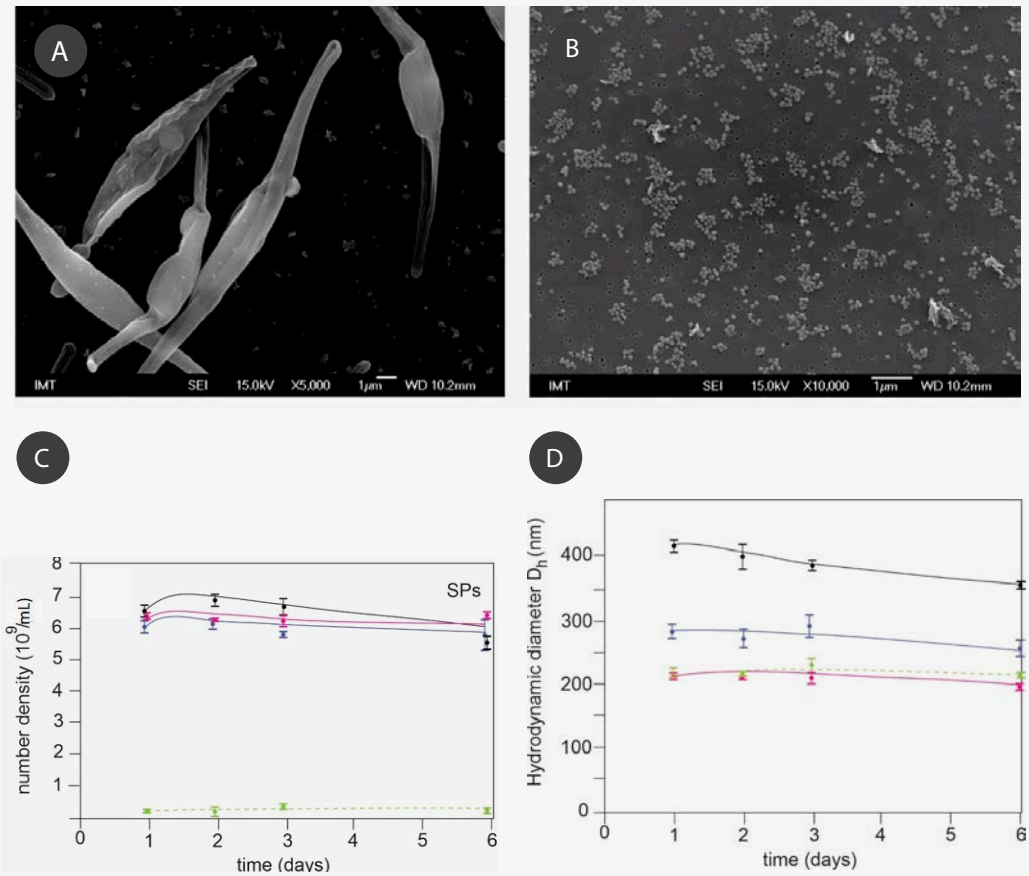


Fig. (A) SEM images of Microalgae Phaeodactylum tricornutum, **(B)** SEM image of SCPs in conditioned media of Phaeodactylum tricornutum. **(C)** Number density of small particles (SPs) in dependence on time. **(D)** Hydrodynamic diameter of small particles (SPs) in the samples of microalgae with added hybridosomes.
Legend: Magenta: samples with added hemp hybridosomes, blue: sample with added spruce hybridosomes, black: samples with added liposomes, green: control samples.

Microalgae are a focus of extensive study due to their abundance and capacity to generate extracellular vesicles cost-effectively. In this particular study, nanoparticles from culture supernatant were directly analyzed without any isolation step. Both studies highlight Videodrop's capacity to analyze raw samples without isolation or purification steps, valuable for bioproduction or clinical biological sample analysis.

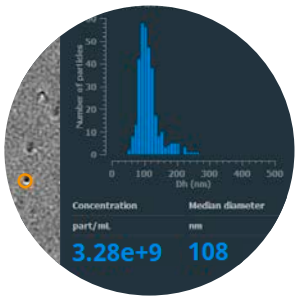
VIDEO DROP

SC

Measuring
Size & Concentration
of Nanoparticles

IN A SINGLE DROP

IN REAL TIME



REPRODUCIBLE RESULTS

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