TriTom™ Contrast Agent Development

The development of novel optical imaging contrast agents requires extensive testing in both phantoms and animal models to ensure the safety and utility of the agent for in vivo applications. However, evaluating the biodistribution and clearance of a contrast agent remains challenging in preclinical studies due to limited whole-body real-time imaging technologies. The TriTom is a multimodal imaging platform that provides high-resolution photoacoustic (PA) and fluorescence (FL) images of small animal models. Here, we demonstrate TriTom analysis of a novel photoacoustic agent and highlight the system's unique advantages for advancing optical contrast agent development.

SYSTEM SPECIFICATIONS

Imaging System	TriTom™
Excitation Wavelengths	460 - 1300nm
Spatial Resolution	Up to 160 µm (PA) Up to 70 µm (FL)
Acquisition Time	36 s per scan

Contrast Agent Characterization

A critical step in developing novel photoacoustic contrast agents is determining the wavelength-dependent photoacoustic absorption spectrum. Indocyanine green (ICG) is a popular component of these agents, partly due to the ability to easily form J-aggregates (ICG-JA), which have increased stability and a stronger optical absorption in the NIR window. The TriTom provides high-resolution and high-sensitivity volumetric images of up to ten contrast agent samples in a single scan and requires minimal volumes (< 50 µL), which is beneficial for evaluating expensive or difficult-to-make contrast agents. Additionally, the ability to investigate multiple agents in a single scan allows for direct comparison to controls or other gold-standard references.

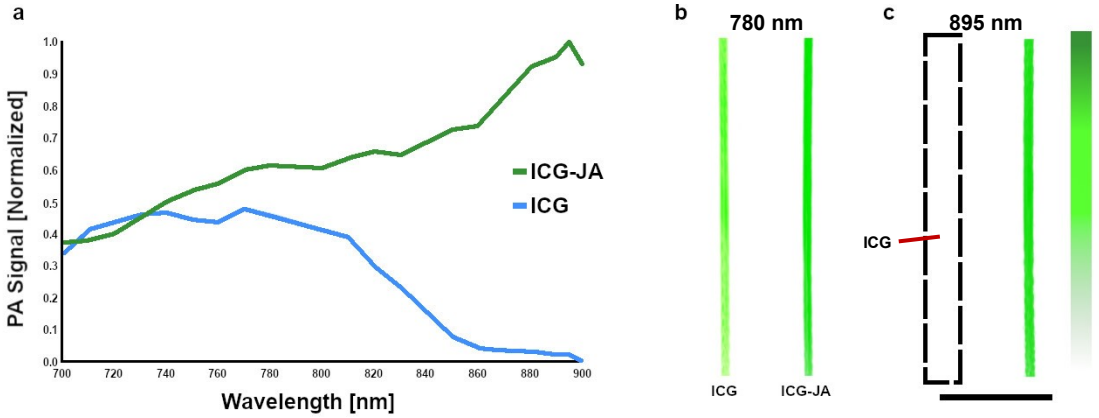
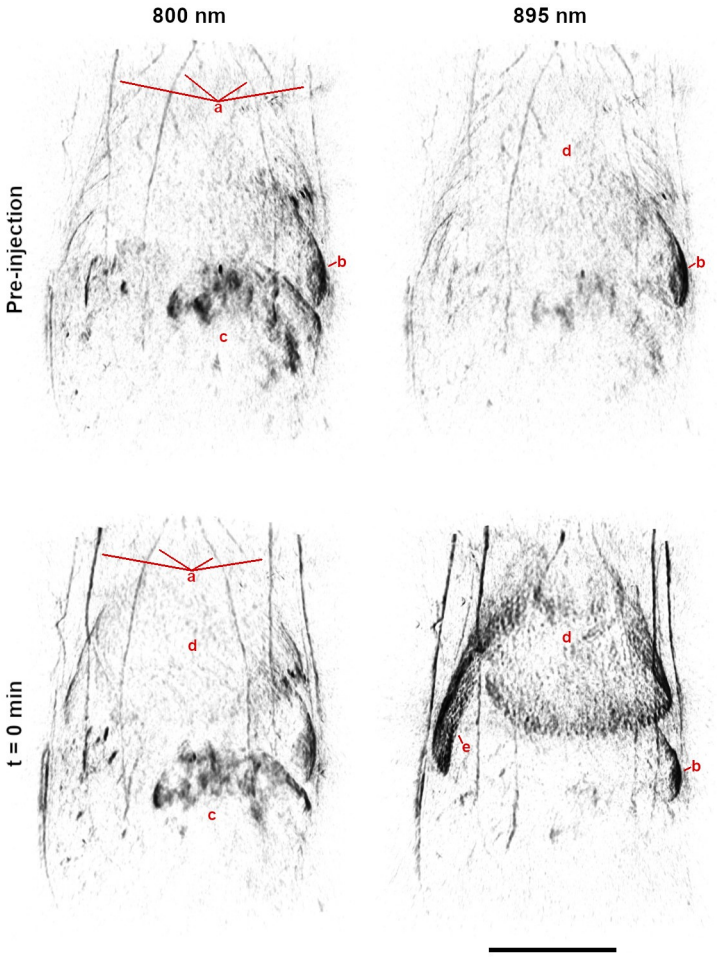


Figure 1: (a) Photoacoustic spectrum of ICG and ICG-JA measured with the TriTom. (b, c) 3D TriTom images of a sample phantom containing the same concentration of ICG and ICG-JA acquired with 780 nm (b) and 895 nm (c) laser excitation. Scale bar = 10 mm. Data reproduced from [1].

Application Note



Contrast Biodistribution

Preclinical evaluation of the biodistribution and clearance of optical absorbers in healthy animal models are necessary to clinical translation of new contrast agents. However, these studies typically require large sample sizes or indirect measures due to inadequate tools for whole-body imaging. The TriTom provides high-resolution images of large volumes (> 30 cm^3), enabling whole-body anatomical and molecular analysis of the contrast agent biodistribution. Further, the fast scan time (< 36 s) allows for functional imaging of the agent's dynamics, physiologic interaction, and clearance mechanisms. These features allow for the direct, quantitative assessment of the agent *in vivo*, making the TriTom an ideal tool for developing novel optical contrast agents.

Figure 2: Reconstructed PA coronal volumes showing the *in vivo* biodistribution of 0.4 mM ICG (left) compared to ICG-JA (right). The TriTom's high-resolution imaging allows for whole-body evaluation of contrast agent dynamics, accumulation, and clearance. (a) thoracic arteries; (b) spleen; (c) intestines; (d) liver (left lobe); (e) liver (median lobe). Scale bar = 10mm. [1]

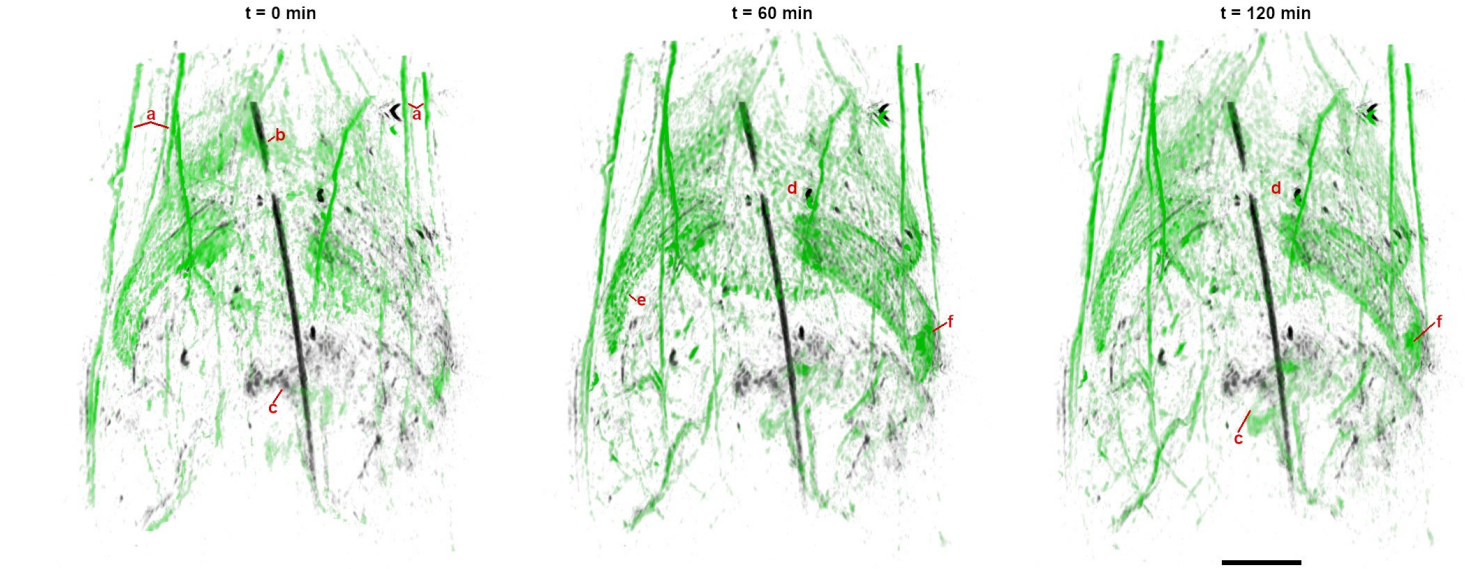


Figure 3: Molecular unmixing of ICG-JA (green) overlaid on the pre-injection anatomical image (black) acquired with 800 nm laser excitation [1]. The 3D TriTom images show the longitudinal accumulation of the targeted ICG-JAs in the vasculature and provide an *in vivo* molecular analysis of their clearance mechanism. (a) thoracic arteries; (b) $CuSO_2$ fiducial; (c) intestines; (d) liver (left lobe); (e) liver (median lobe); (f) spleen). Scale bar = 5mm.

References

[1] S. Singh et al., *Photoacoustics* 29 (100437), doi: 10.1016/j.pacs.2022.100437 (2023).

東京インスツルメンツ
TOKYO INSTRUMENTS
グローバルにネットワークを広げ、最先端の科学をお客様に提供

本　社：〒134-0088 東京都江戸川区西葛西6-18-14 T.I.ビル　Tel. 03-3686-4711
営業所：〒532-0003 大阪府大阪市淀川区宮原4-1-46 新大阪北ビル　Tel. 06-6393-7411
URL：https://www.tokyoinst.co.jp　Mail：sales@tokyoinst.co.jp