

Image Processing to Enhance the Visibility of Curcumin Conjugated Nanoparticles in Cell Nuclei

*Original*

Image Processing to Enhance the Visibility of Curcumin Conjugated Nanoparticles in Cell Nuclei / Sparavigna, Amelia Carolina. - In: PHILICA. - ISSN 1751-3030. - ELETTRONICO. - (2017).

*Availability:*

This version is available at: 11583/2694409 since: 2017-12-08T20:35:36Z

*Publisher:*

PHILICA, Salisbury

*Published*

DOI:

*Terms of use:*

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

*Publisher copyright*

(Article begins on next page)

# Image Processing to Enhance the Visibility of Curcumin Conjugated Nanoparticles in Cell Nuclei

*Amelia Carolina Sparavigna (Department of Applied Science and Technology, Politecnico di Torino)*

Published in [bio.philica.com](http://bio.philica.com)

## Abstract

Here we discuss a method based on GIMP software for enhancing the visibility of the curcumin conjugated nanoparticles in an image showing glioma cells.

The Nanotechnology Image Library is a remarkable source of images that we can use for the development of image processing methods, suitable for some studies concerning medical imaging. Let us consider one of the images. It is showing nanoparticles in glioma cell (Figure 1). In particular the description given at page [visuals.nci.nih.gov/details.cfm?imageid=11261](https://visuals.nci.nih.gov/details.cfm?imageid=11261) allows us to understand the role of the different colours in the image. Since water-insoluble compounds, like curcumin, can be difficult to deliver to the cells because they cannot move in a watery environment, nanoparticles are used to transport them (some references about curcumin nanoparticles are given [1-6]). The nanoparticles become carriers of water-insoluble compounds to reach the cancer cells. In the description at the page of the Library it is also told that the nanoparticles can transport the compounds across the blood-brain barrier, the protective shield around blood vessels of the brain. Image 11261 shows that the curcumin-conjugated nanoparticles, which are green colored in the image, were able to reach the nuclei (blue colored) of brain tumor cells in mice. The creator of the image is Doctor Meser M. Ali, National Cancer Institute, Henry Ford Hospital, who is studying glioma and glioma imaging [7-11].

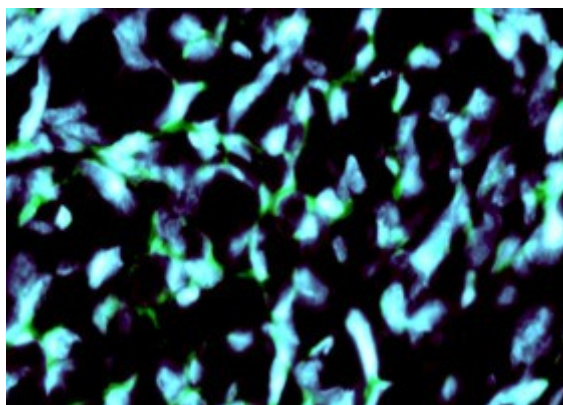


Figure 1: The image shows that curcumin-conjugated nanoparticles (green) have reached the nuclei (blue) of brain tumor cells, as given in <https://visuals.nci.nih.gov/details.cfm?imageid=11261>

Let us consider the image and investigate a method to enhance the visibility of the green colored

particles in the image. This can be obtained using GIMP, in the manner similar to those already proposed in [12-14]. Actually, in the given references, we used the method to enhance differences between images to study the motion of sand dunes and clouds. GIMP is the GNU Image Manipulation Program, a cross-platform image editor available for GNU/Linux, OS X, Windows and more operating systems. It is a free software. Other features of GIMP are useful too [15-19], in particular its Retinex tool. We will use the Retinex tool to evidence the curcumin nanoparticles.

First, we use GIMP and its Channel Dialog interface to manage the RGB colours. We have three channels (Red, Green, and Blue) as primary colors. If we select only the Blue channel, we see the image A in the Figure 2. If we use only the Green channel, we obtain the image B in the same Figure. Using the Desaturate Command of GIMP, we obtain images A' and B'. The Desaturate Command has three options - Lightness, Luminosity, and Average - which are illustrated by the tutorial [www.gimp.org/tutorials/Digital\\_Black\\_and\\_White\\_Conversion/](http://www.gimp.org/tutorials/Digital_Black_and_White_Conversion/) . Here we used the Luminosity option.

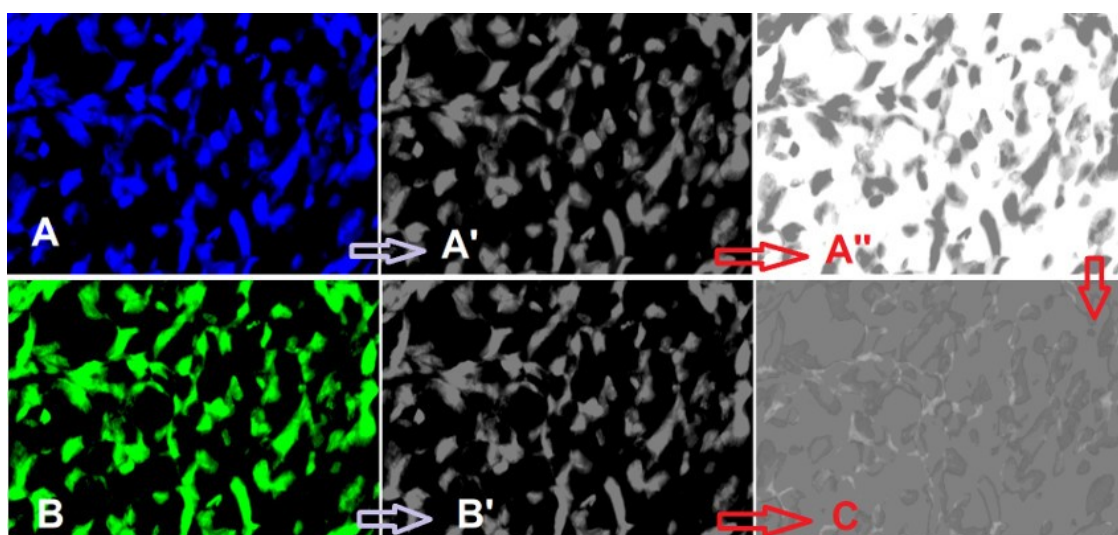


Figure 2: Using GIMP we obtain from the Figure 1 two images. A corresponds to the Blu channel, B to the Green channel. A' and B' are the corresponding grey-tone maps. A' is inverted to have A''. Using A'' and B' we have map C.

A' and B' look as the same image, but it is not so. They are giving different information. To evidence the difference, we use the approach proposed in [12-14]. A' is converted into A'', by means of the inversion of the grey tones. The layer of the image A'' is placed on image B'. Opacity of A'' is reduced of 50%. The result is given in the image C. We see bright and dark domains in the grey background. This background is composed by the pixels of the two images which are giving the same information. The bright pixels are those where green is predominant, the dark pixels where blue is prevalent. To have a better appreciation of differences, we can filter C by means of GIMP Retinex. The result is given in the right panel of the Figure 3. On the left, we see the original image.

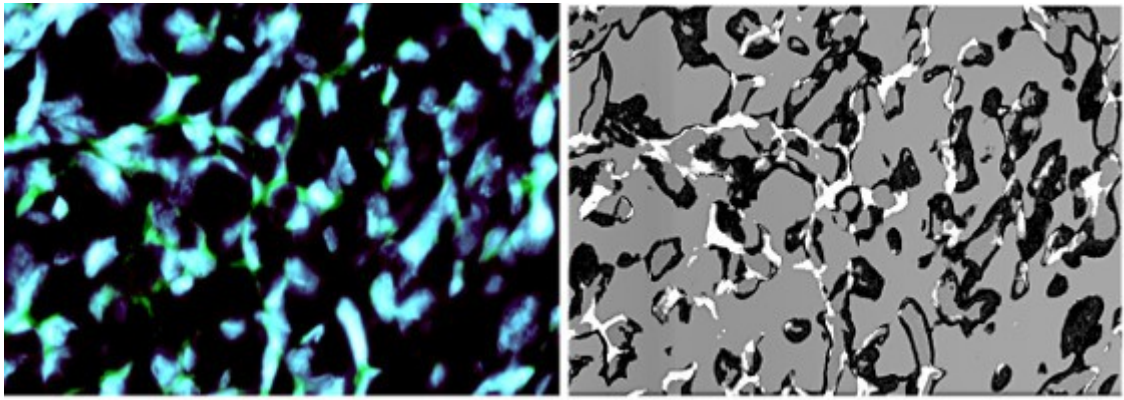


Figure 3: The original image (left) can be compared to the map which is revealing the different information coming from Blue and Green channels.

The map shows that the presence of curcumin seems larger than that we can appreciate from the original image. Further studies are necessary to test the method and for its use for quantitative measurements.

## References

- [1] Bisht, S., Feldmann, G., Soni, S., Ravi, R., Karikar, C., Maitra, A., & Maitra, A. (2007). Polymeric nanoparticle-encapsulated curcumin ("nanocurcumin"): a novel strategy for human cancer therapy. *Journal of nanobiotechnology*, 5(1), 3.
- [2] Das, R. K., Kasoju, N., & Bora, U. (2010). Encapsulation of curcumin in alginate-chitosan-pluronic composite nanoparticles for delivery to cancer cells. *Nanomedicine: Nanotechnology, Biology and Medicine*, 6(1), 153-160.
- [3] Yallapu, M. M., Gupta, B. K., Jaggi, M., & Chauhan, S. C. (2010). Fabrication of curcumin encapsulated PLGA nanoparticles for improved therapeutic effects in metastatic cancer cells. *Journal of colloid and interface science*, 351(1), 19-29.
- [4] Bisht, S., Mizuma, M., Feldmann, G., Ottenhof, N.A., Hong, S.M., Pramanik, D., Chenna, V., Karikari, C., Sharma, R., Goggins, M.G., & Rudek, M.A. (2010). Systemic administration of polymeric nanoparticle-encapsulated curcumin (NanoCurc) blocks tumor growth and metastases in preclinical models of pancreatic cancer. *Molecular cancer therapeutics*, 9(8), pp.2255-2264.
- [5] Basniwal, R. K., Buttar, H. S., Jain, V. K., & Jain, N. (2011). Curcumin nanoparticles: preparation, characterization, and antimicrobial study. *J. Agric. Food Chem*, 59(5), 2056-2061.
- [6] Gupta, V., Aseh, A., Ríos, C. N., Aggarwal, B. B., & Mathur, A. B. (2009). Fabrication and characterization of silk fibroin-derived curcumin nanoparticles for cancer therapy. *International journal of nanomedicine*, 4, 115.
- [7] Gonawala, S., & Ali, M. M. (2017). Application of Dendrimer-based Nanoparticles in Glioma Imaging. *Journal of nanomedicine & nanotechnology*, 8(3).
- [8] Varma, N.R.S., Janic, B., Iskander, A.S.M., Shankar, A., Bhuiyan, M.P., Soltanian-Zadeh, H., Jiang, Q., Barton, K., Ali, M.M. and Arbab, A.S., 2012. Endothelial progenitor cells (EPCs) as gene

carrier system for rat model of human glioma. PLoS One, 7(1), p.e30310.

[9] Karki, K., Ewing, J.R. and Ali, M.M., 2016. Targeting Glioma with a Dual Mode Optical and Paramagnetic Nanoprobe across the Blood-brain Tumor Barrier. *Journal of nanomedicine & nanotechnology*, 7(4).

[10] Varma, N. R. S., Barton, K. N., Janic, B., Shankar, A., Iskander, A. S. M., Ali, M. M., & Arbab, A. S. (2013). Monitoring adenoviral based gene delivery in rat glioma by molecular imaging. *World journal of clinical oncology*, 4(4), 91.

[11] Ali, M.M., Kumar, S., Shankar, A., Varma, N.R., Iskander, A.S.M., Janic, B., Chwang, W.B., Jain, R., Babajeni-Feremi, A., Borin, T.F. and Bagher-Ebadian, H., 2013. Effects of tyrosine kinase inhibitors and CXCR4 antagonist on tumor growth and angiogenesis in rat glioma model: MRI and protein analysis study. *Translational oncology*, 6(6), pp.660-669.

[12] Sparavigna, A. C. (2016). Analysis of the Motion of Some Brazilian Coastal Dunes, *International Journal of Sciences* 5(01), 22-31. DOI: 10.18483/ijSci.905

[13] Sparavigna, A. C. (2014). Cloud Tracking in METEOSAT Images Using GIMP Program, *International Journal of Sciences* 3(11), 18-21. DOI: 10.18483/ijSci.596

[14] Sparavigna, A. C. (2013). The GNU Image Manipulation Program Applied to Study the Sand Dunes, *International Journal of Sciences* 2(09), 1-8. DOI: 10.18483/ijSci.289

[15] Sparavigna, A. C. (2014). GIMP and Wavelets for Medical Image Processing: Enhancing Images of the Fundus of the Eye, *International Journal of Sciences* 3(08), 35-47. DOI: 10.18483/ijSci.556

[16] Sparavigna, A. C. (2015). An Image Processing Approach Based on Gnu Image Manipulation Program Gimp to the Panoramic Radiography, *International Journal of Sciences* 4(05), 57-67. DOI: 10.18483/ijSci.721

[17] Sparavigna, A. C. (2015). Gimp Retinex for Enhancing Images from Microscopes, *International Journal of Sciences* 4(06), 72-79. DOI: 10.18483/ijSci.758

[18] Sparavigna, A. C., & Marazzato, R. (2015). Effects of GIMP Retinex Filtering Evaluated by the Image Entropy. arXiv preprint arXiv:1512.05653.

[19] Sparavigna, A. (2015). Retinex filtering and thresholding of foggy images. *PHILICA Article number* 511.

### Information about this Article

Published on Friday 8th December, 2017 at 19:08:04.

#### The full citation for this Article is:

Sparavigna, A. C. (2017). Image Processing to Enhance the Visibility of Curcumin Conjugated Nanoparticles in Cell Nuclei. *PHILICA Article number* 1183.