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GRAYSCALE BOX COUNTING FOR TEXTURE ANALYSIS IN LIVER OF COMMON CARP (*CYPRINUS CARPIO*) SUB-CHRONICALLY EXPOSED TO PERFLUOROCTANOIC ACID (PFOA)

Maurizio Manera¹, Bahram Sayyaf Dezfuli², Giuseppe Castaldelli² and Luisa Giari²

¹University of Teramo, Italy

²University of Ferrara, Italy

Liver texture was comparatively assessed in 20 specimens of carp after experimental exposure to two PFOA dosages (10 exposed to 200 ng l⁻¹, 10 exposed to 2 mg l⁻¹) for 56 days and in 10 unexposed (Ctr) specimens. Grayscale differential box counting (mass fractal dimension, DM and lacunarity, λ [Lac]; FracLac plugin in ImageJ package; Fig. 1) was adopted on images previously assessed for texture by means of MaZda software. Linear Discriminant Analysis on grayscale box counting data failed to discriminate with confidence between treated and untreated fish (40% of cases correctly classified: sensitivity of 69.0%, specificity of 52.6%) with particular regard to low dosage group (only 10% of Ctr cases correctly classified). Nevertheless, referring to the cumulative Redundancy Analysis ordination space (Fig. 2), the more the liver PFOA content augmented, the more the number of cells positive to Proliferating Cell Nuclear Antigen (PCNA), the liver mass, DM and λ (hence gray level pattern complexity) increased and Sum Entropy (hence the disorder of a vector from the gray level co-occurrence matrix) decreased. To date the exact biological implication of such correlations is not known, with lacunarity increase possibly due to hepatocyte degeneration (increased vacuolisation), though it surely deserves further investigation in order to use grayscale box counting with confidence in biomarker evaluation in course of environmental monitoring.

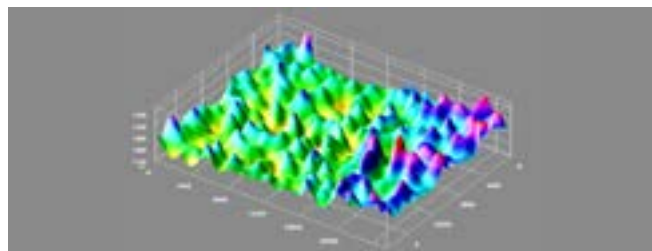


Figure 1: The image represents the surface plot of a microphotograph taken from a liver section of a high dosage treated fish. Differential box counting is implemented by converting 2D grayscale images into 3D information, then projecting the image into volumes after partitioning it into areas.

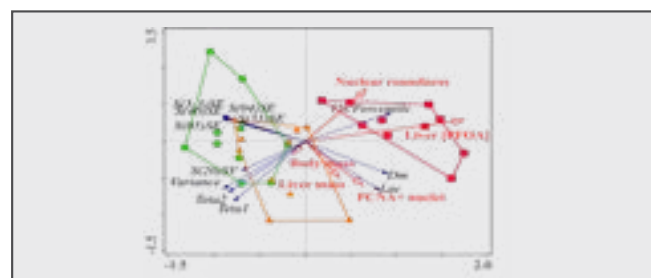


Figure 2: Redundancy Analysis ordination tri-plot of texture features data, biometric and chemical data. (? , untreated; ? , low dosage; I, high dosage). High dosage group is separated from the other groups along a gradient due to liver PFOA concentration and, in part, due to nuclear roundness and PCNA nuclear positivity. The correlation between PCNA nuclear positivity, liver mass and DM and ? [Lac] is also appreciable.

Biography

Maurizio Manera has completed his PhD in Veterinary Pathology at Bologna University and MSc in Environmental Science at L'Aquila University. He is an Assistant Professor in Image Analysis in Histopathology and in Biomarkers in Environmental Monitoring. He has published 74 papers in indexed reputed journals and has been serving as an Editorial Board Member of reputed journals.

mmanera@unite.it