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Effects of Ionizing Radiation on the Color and Morphological Properties of Leather

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1. Introduction

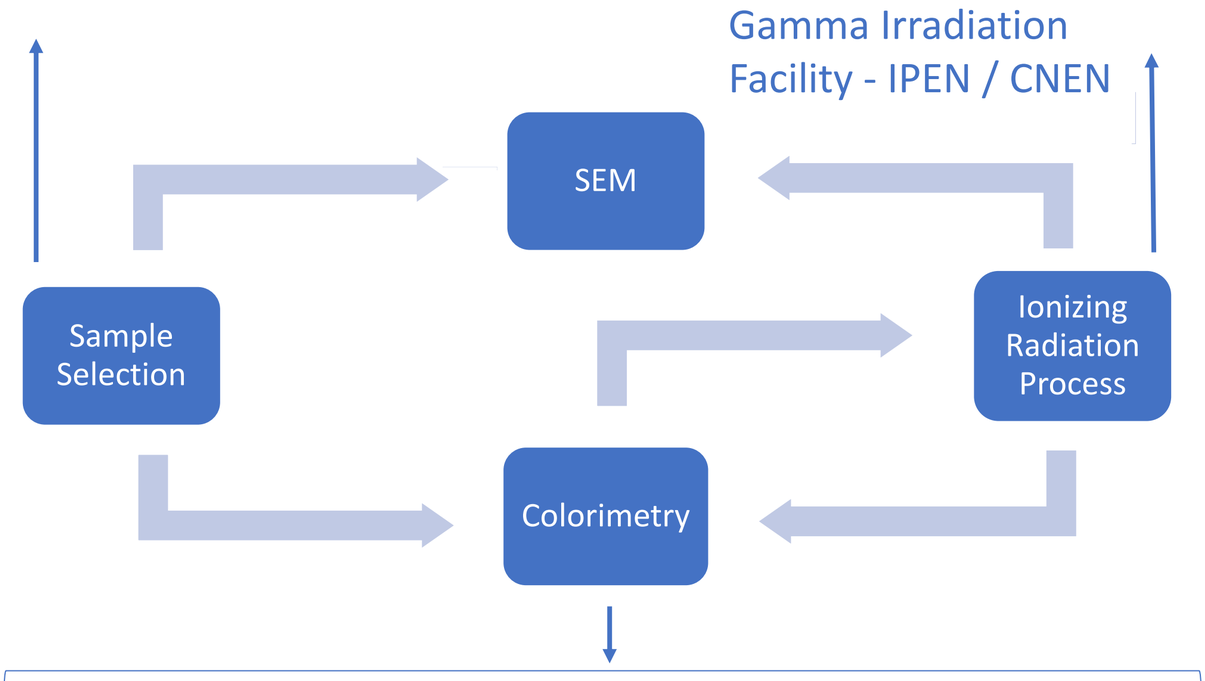
Leather, a processed and stabilized animal skin, is a valuable component of cultural heritage collections. However, its organic nature makes it susceptible to biological degradation, especially in tropical climates. Traditional conservation methods may pose risks. Ionizing radiation has emerged as a non-destructive alternative for preservation. This study investigated the application of gamma radiation, at preliminary doses up to 3 kGy, as a preservation technique for bovine and snake leather samples. The effects on color and morphology properties, two key characteristics of leather, were evaluated.

2. Materials and Methods

Table I: Materials and Method

Sample	Description	Identification
S1BC	Species: *Bos taurus* Tanning Process: Chrome Color: Caramel (Dyed)	
S2CK	Species: Bungarus fasciatus Tanning Process: Vegetable Color: Natural (Undyed)	

Figure 1: Multipurpose Gamma Irradiation Facility - IPEN / CNEN



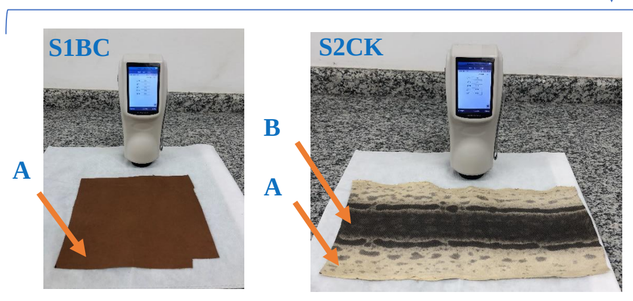


Figure 2: Measurement locations

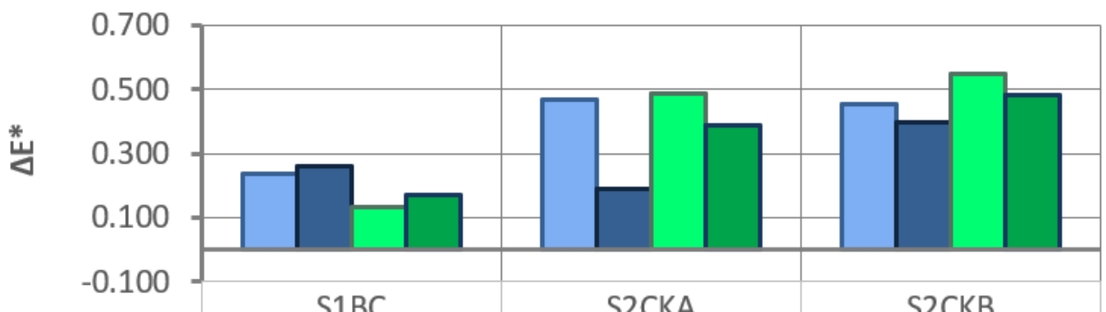
Table II: Hardeberg Criteria Color difference (ΔE*)

ΔE*	Effect
< 3	Hardly perceptible
3 < 6	Perceptible, but acceptable
> 6	Not acceptable

3. Results and Discussion

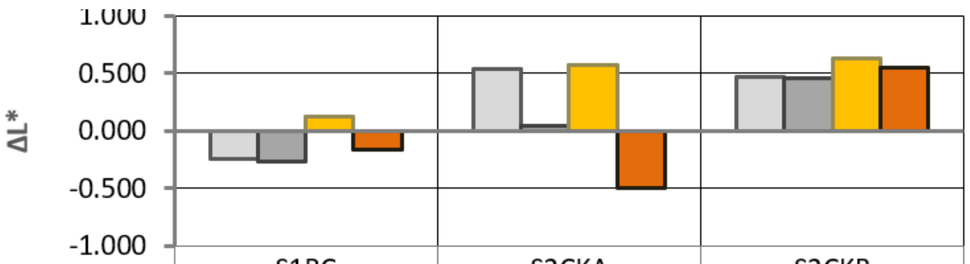
Colorimetric Analysis

a) Total Color Difference ΔE*



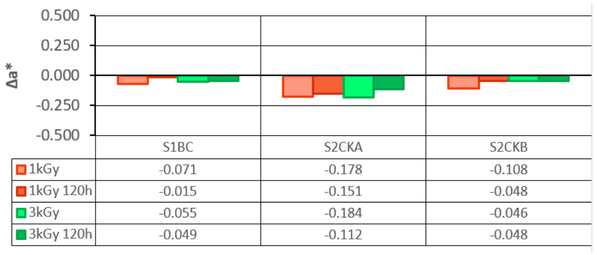
	S1BC	S2CKA	S2CKB
1kGy	0.239	0.470	0.453
1kGy 120h	0.262	0.191	0.399
3kGy	0.134	0.488	0.547
3kGy 120h	0.171	0.390	0.483

b) Lightness Difference ΔL*



	S1BC	S2CKA	S2CKB
1kGy	-0.243	0.540	0.473
1kGy 120h	-0.269	0.046	0.458
3kGy	0.119	0.570	0.630
3kGy 120h	-0.160	-0.496	0.550

c) Red-green difference Δa*



	S1BC	S2CKA	S2CKB
1kGy	-0.071	-0.178	-0.108
1kGy 120h	-0.015	-0.151	-0.048
3kGy	-0.055	-0.184	-0.046
3kGy 120h	-0.049	-0.112	-0.048

d) Yellow-Blue difference Δb*

	S1BC	S2CKA	S2CKB
1kGy	0.041	0.245	-0.210
1kGy 120h	0.102	0.091	-0.074
3kGy	0.077	0.227	-0.096
3kGy 120h	0.099	-0.204	-0.121

Figure 3: Selected points after irradiation - 1 kGy and 3 kGy a) ΔE*, b) ΔL*, c) Δa* and d) Δb*

Scanning Electron Microscope (SEM) Analysis

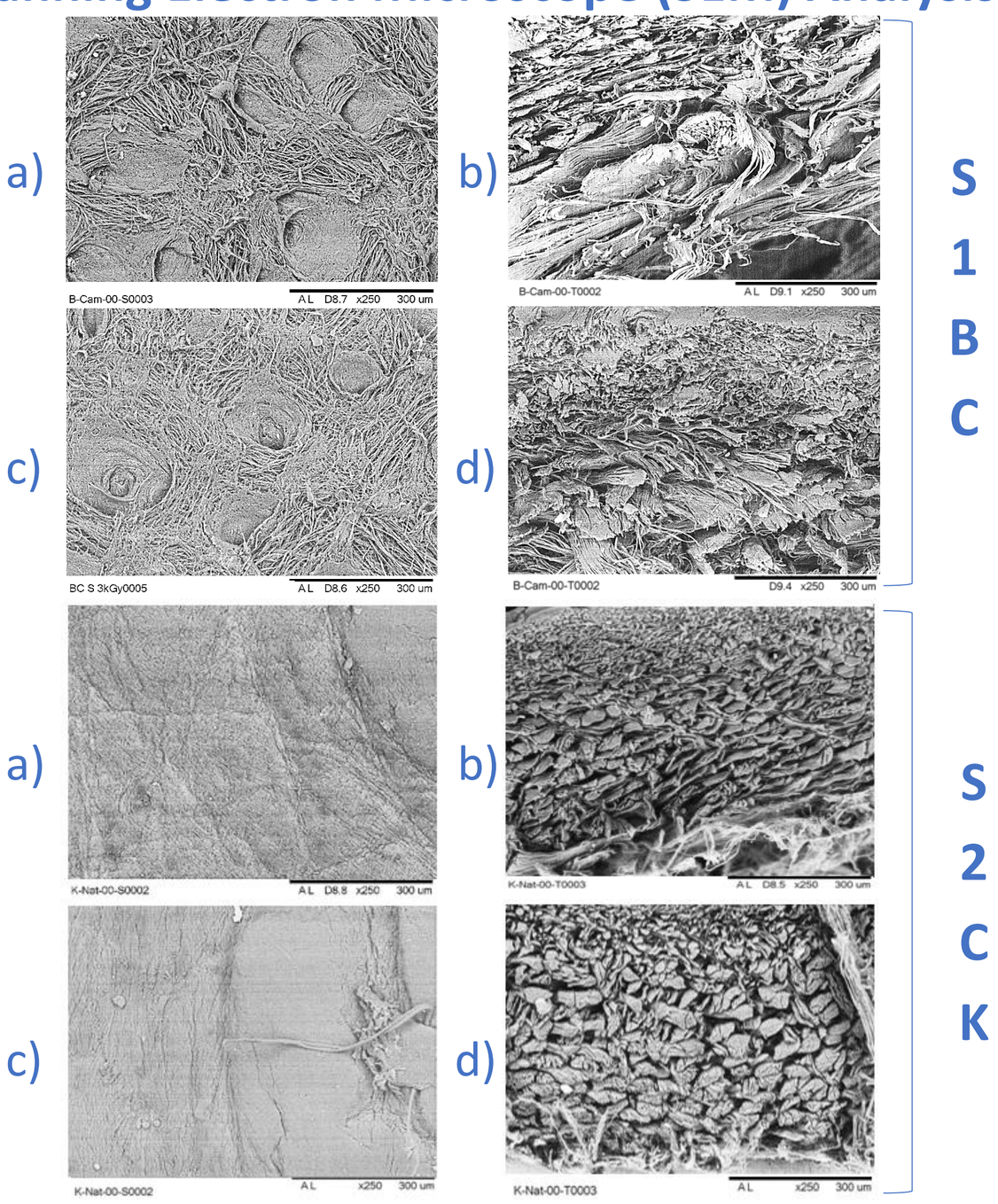


Figure 4: SEM micrographs - Non–irradiated: a) surface b) cross-section / Irradiated 3kGy: c) surface d) cross-section

4. Conclusions

- ✓ Gamma radiation demonstrated minimal impact on the color and morphology.
- ✓ Colorimetric analysis: total color difference remained within acceptable limits (ΔE < 3).
- ✓ SEM micrographs: no significant alterations in topography or internal fiber structures.
- ✓ Future work: expand the investigation by using higher radiation doses and incorporating a variety of leather species.

References

[1] Kite, M., Thomson, R., "Conservation of Leather and Related Materials", Routledge, New York, USA (2011).
[2] International Atomic Energy Agency. "Uses of Ionizing Radiation for Tangible Cultural Heritage Conservation". 1. Ed. Vienna, Austria. (2017).
[3]Hardeberg, J.Y. Acquisition et reproduction d'images couleur: approches colorimétrique et multispec-trale. Interface homme-machine [cs.HC]. Télécom ParisTech, Paris, Français (1999).

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