Valorization of shea butter from local production in Benin: a phytochemical and pharmacological study

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Background

- *Vitellaria paradoxa* C.F. Gaertn. (Fam. Sapotaceae), commonly known as the shea butter tree, is endemic to sub-Saharan Africa [1].
- Its kernels produce shea butter (*Butyrospermum parkii)*, used in food, cosmetics, and traditional medicine [1].
- Traditionally applied for burns, wounds, scars, and skin infections [1].
- Previous evidence showed antioxidant, anti-inflammatory, and wound-healing properties of shea butters [2,3].
- Scientific interest in its bioactive compounds continues to grow, aiming to validate traditional uses and explore therapeutic applications.

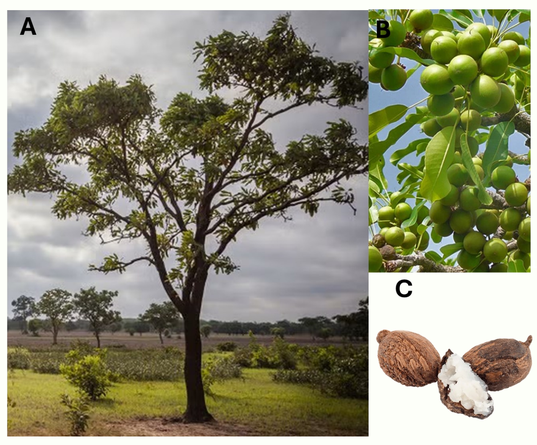


Figure 1. Image of *Vitellaria paradoxa* C.F. Gaertn tree (A), leaves and fruits (B), and shea butter (C).

Aim of the study

To characterize the phytochemical profile and bioactivities of a shea butter sample produced by the TIKKONA Cooperative in the Republic of Benin (named KAR-T), in comparison with a commercial product (KAR-K), in order to give scientific basis to the traditional use and valorize the value local production.

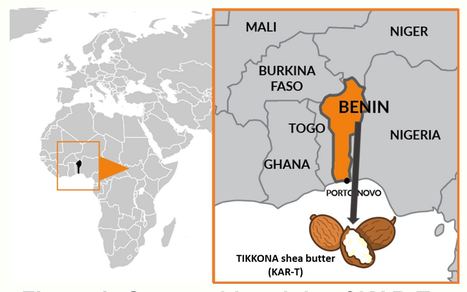


Figure 2. Geographic origin of KAR-T.

Experimental design

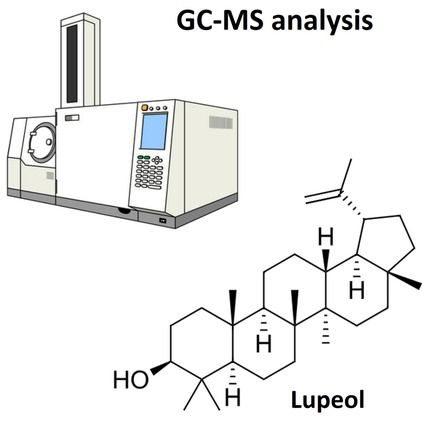
- Comparative analysis of local (KAR-T) vs commercial (KAR-K)
- Phytochemical characterization by gas chromatography/mass spectrometry (GC/MS) .
- Screening of bioactivities, including cytotoxicity in human malignant melanoma A375 cells and HFF-1 noncancerous fibroblasts, in human malignant melanoma A375 cells and HFF-1 noncancerous fibroblasts, cytoprotection against oxidative damage, in terms of cell viability restoration and oxidative stress inhibition, and wound healing in HFF-1 cells.

RESULTS

PHYTOCHEMICAL COMPOSITION

Table 1. Compounds identified at GC-MS analysis. Relative percentage of identified fatty acids is displayed.

	TRITERPENES	FATTY ACIDS	%
KAR-K	Lupeol	Palmitic acid	37,1
		Linolelaidic acid	1,2
		Oleic acid	16.8
		Stearic acid	44,4
		Eicosanoic acid	0.5
KAR-T	Lupeol	Palmitic acid	4.0
		Linolelaidic acid	3.1
		Oleic acid	50.8
		Stearic acid	41.4
		Eicosanoic acid	0.7



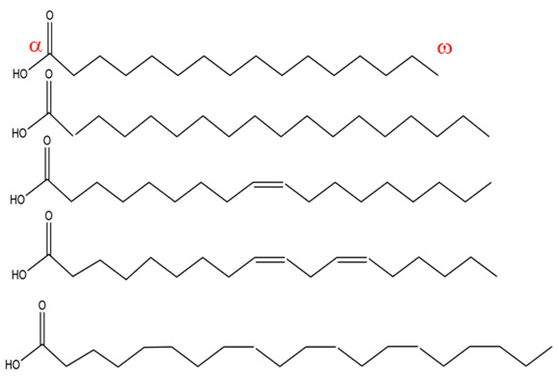


Figure 3. Chemical structure of the main bioactive compounds identified in the tested shea butters at GC-MS analysis, including the triterpene lupeol and the major fatty acids (palmitic acid, stearic acid, oleic acid, linolelaidic acid (t,t-linoleic acid), and eicosanoic acid.

BIOLOGICAL ACTIVITIES

Cytotoxicity in human A375 cancer melanocytes and HFF-1 noncancerous fibroblasts

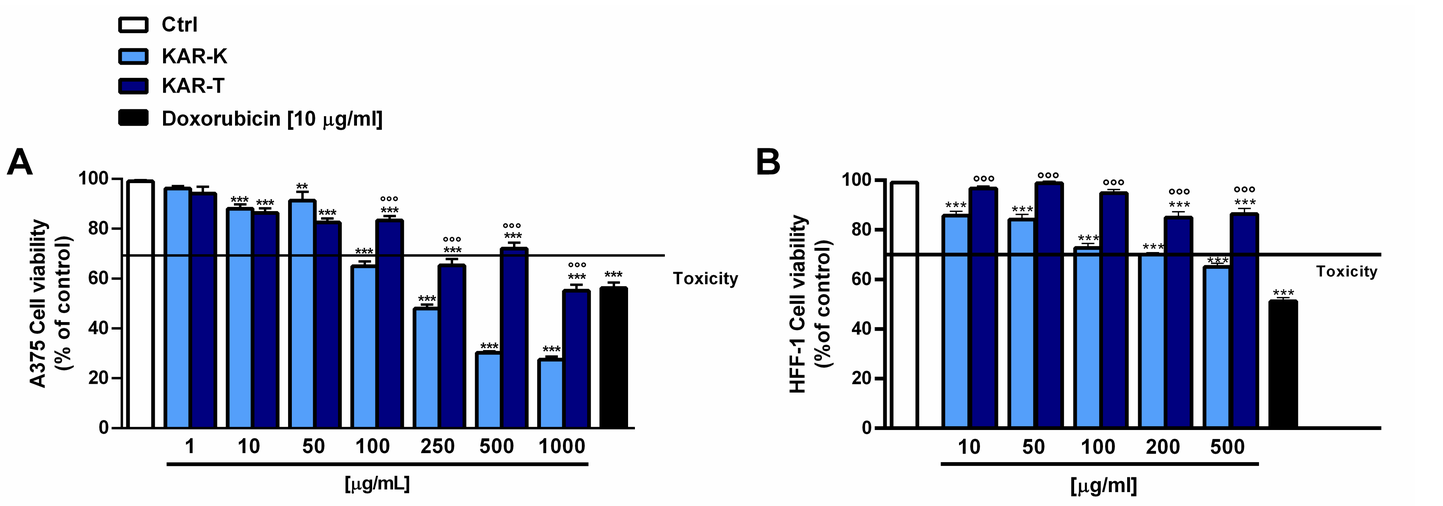


Figure 4. Effect of KAR-K and KAR-T shea butters and the positive control doxorubicin on the viability of human A375 cancer melanocytes (A), and HFF-1 foreskin fibroblasts (B) after 24 h exposure. Data represent the average and standard error of at least three independent experiments, each one with at least three technical replicates (n = 9). ** $p < 0.01$ and *** $p < 0.001$ denote a significant difference with respect to Ctrl (ANOVA followed by Dunnett's multiple comparison post test). °°° $p < 0.001$ denotes a significant difference between KART-T and KAR-K (Student's t-test).

Cytoprotection against tBOOH-damage in HFF-1 fibroblasts

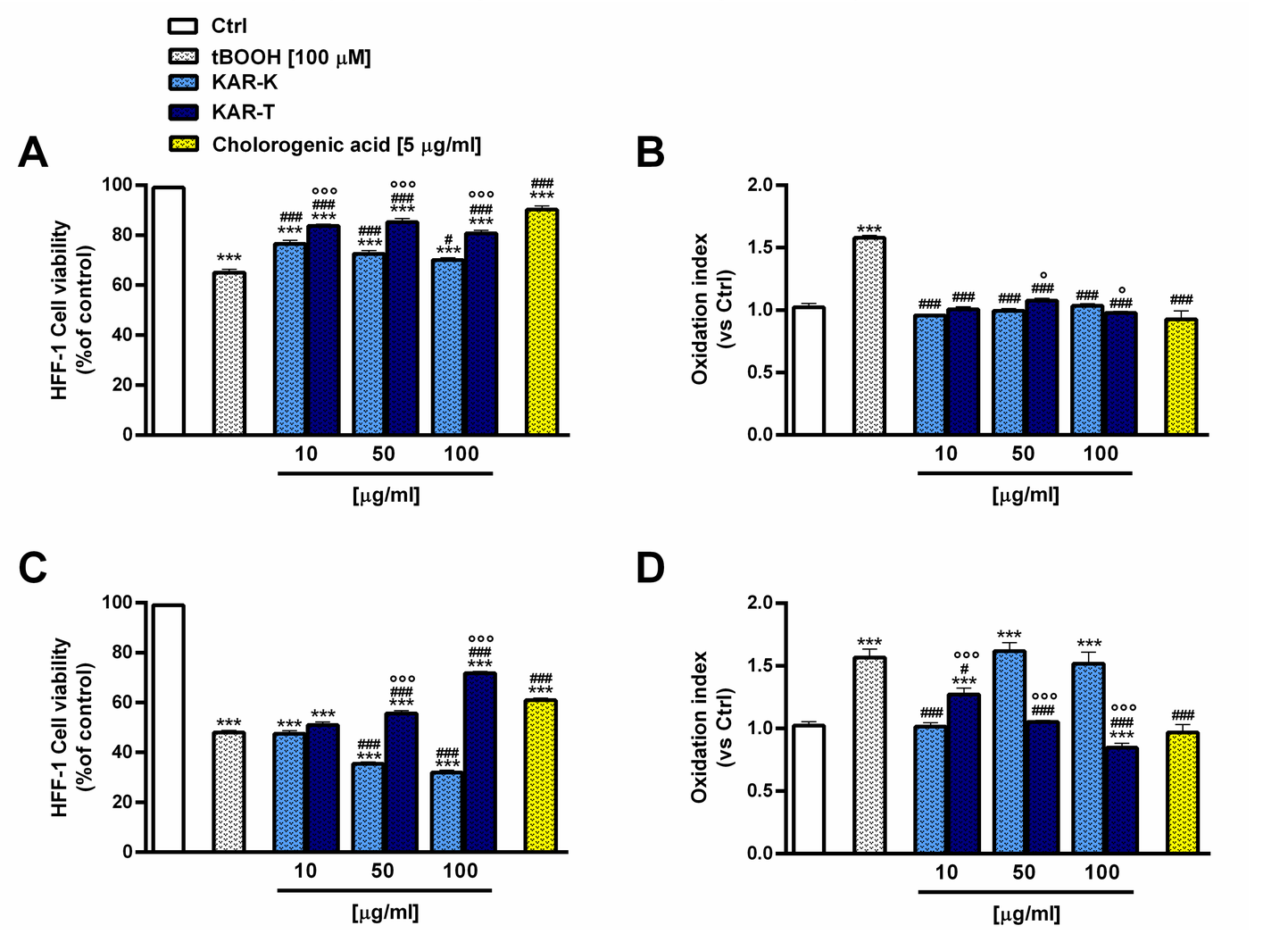


Figure 5. Effect of KAR-K and KAR-T shea butters and the pure compounds chlorogenic acid (CA, 5 μg/ml) towards the oxidative damage induced by tBOOH (100 and 500 μg/ml) on HFF-1 fibroblast viability (A,C) and intracellular oxidative stress (B,D). The cells were pre-treated with the test samples for 24 h, then co-treated with tBOOH for 3 h, after which cell viability and oxidative index were determined. CA was used as a positive control. Data represents the average and standard error of at least three independent experiments, each one with at least two technical replicates (n = 6). *** $p < 0.001$ denotes a significant difference with respect to Ctrl (ANOVA followed by Dunnett's multiple comparison post test). # $p < 0.05$ and ### $p < 0.001$ denote a significant difference with respect to tBOOH (ANOVA followed by Dunnett's multiple comparison post test). °°° $p < 0.001$ denotes a significant difference between KART-T and KAR-K (Student's t-test).

Wound healing activity in HFF-1 fibroblasts

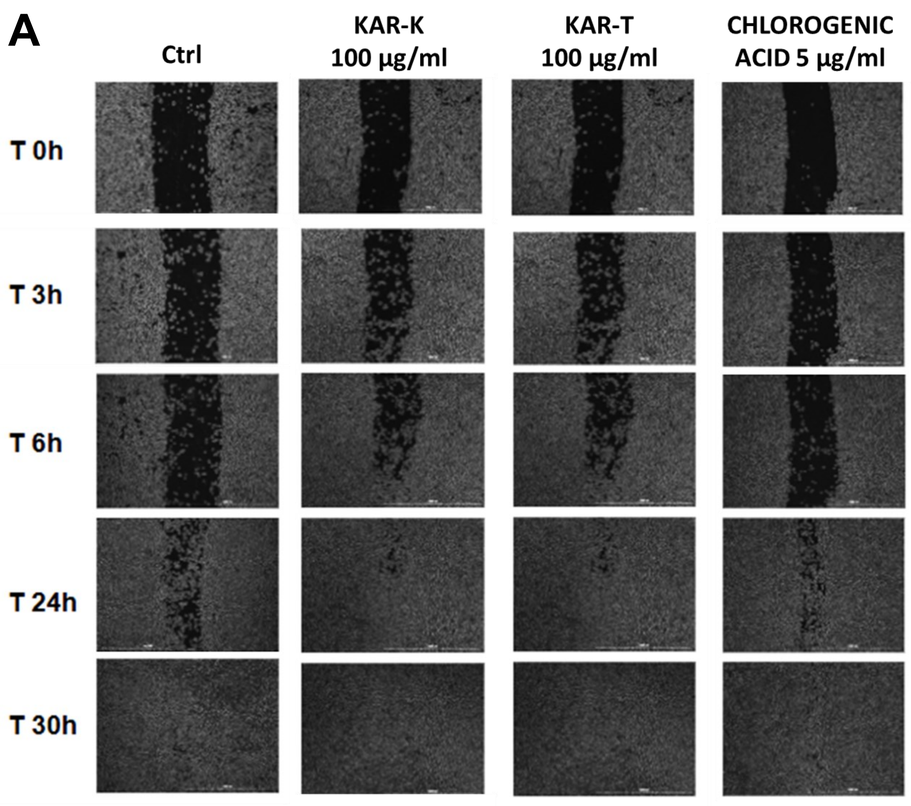


Figure 6. Effect of KAR-K and KAR-T shea butters (100 μg/ml) and the pure compounds chlorogenic acid (CA, 5 μg/ml) on HFF-1 fibroblast migration ability as determined by the wound healing assay. A) Wound images of HFF-1 cells at 0, 3, 6 and 24 h after treatment. Scale bar: 1000 μm. B) Quantification of HFF-1 cells migration rate analyzed by ImageJ at 0, 3, 6 and 24 h after treatment. Results are reported as mean ± SE of wound area percentage of at least two independent experiments with three replicates. ***$p < 0.001$ (one-way ANOVA followed by Dunnett's multiple comparison post-test) vs wound area percentage at t0. °°° $p < 0.001$ denotes a significant difference between KART-T and KAR-K (Student's t-test).

References
[1] Dermatologic Therapy. 2022;35:e14786. [2] Abdel-Razek et al. Foods. 2023;12(8):1626. [3] Treesh et al. Open Vet J. 2021; 10(4):431-437. [4] Di Sotto et al. Biomedicines. 2022;10(9):2257. [5] Luo et al. Food Chem Toxicol. 2025. Feb;196:115193. [6] Farag et al. J Genet Eng Biotechnol. 2022 Mar 16;20(1):48.

CONCLUSIONS

- Phytochemical insights: GC/MS analysis confirmed distinct fatty acid profiles of KAR-T, characterized by high levels of oleic acid, stearic acid and lupeol.
- Higher HFF-1 cell tolerability of KAR-T than KAR-K.
- Bioactivity power: cytoprotection against oxidative damage and enhanced fibroblast migration, promoting significant wound closure within 24 hours, indicating a potential role in oxidative stress regulation and wound repair.
- Pharmacological mechanisms support the traditional use of shea butter in skin disorders.
  → Lupeol and oleic acid as possible bioactive compounds [5,6].

FUTURE PERSPECTIVES

To elucidate the molecular mechanisms underlying the observed effects, define the specific role of bioactive compounds, and confirm the bioactivities through in vivo studies.