Bioactive compounds found in ginger and ginger-containing foods via HPTLC-UV/Vis/FLD-EDA-HRMS

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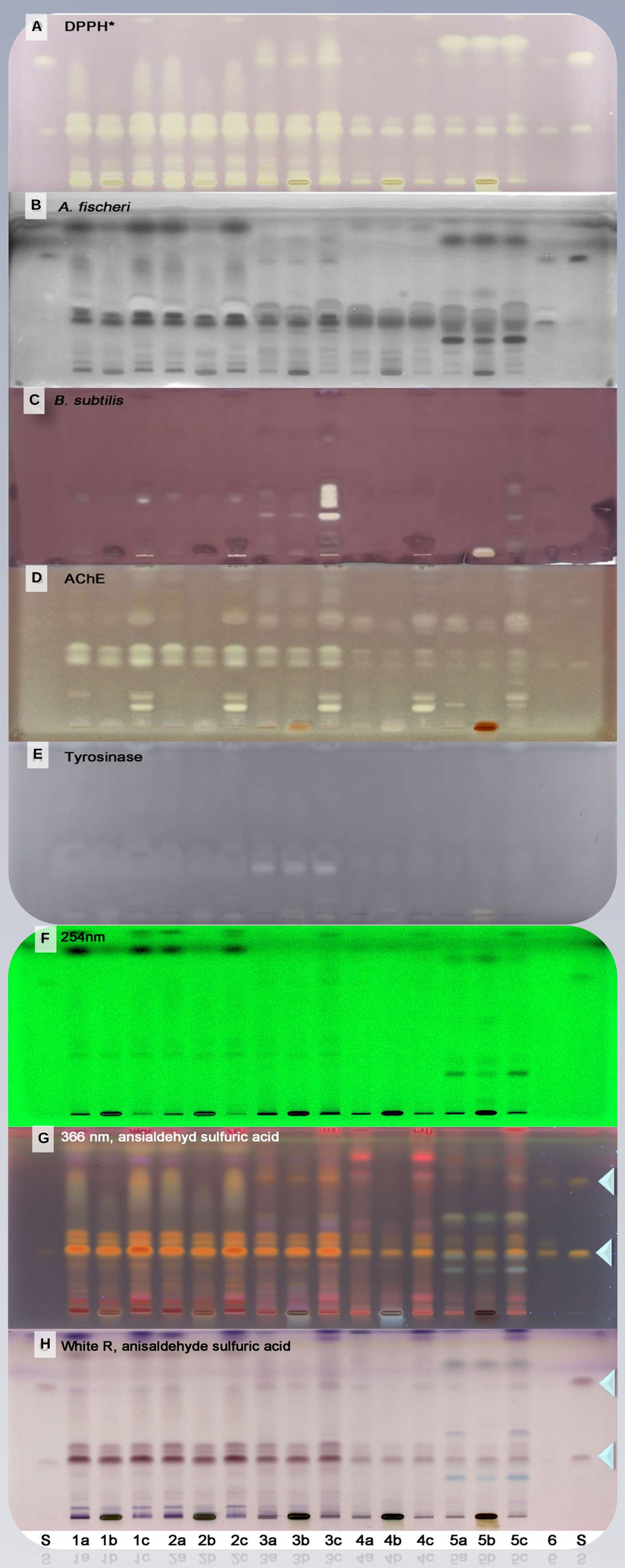
Highlights

- Fast and quantitative bioprofiling of ginger (*Zingiber officinale*) and ginger-containing foods [1]
- Effect-directed analysis (EDA) of radical-scavengers, antimicrobials, estrogens, AChE/tyrosinase inhibitors as well as derivatization with anisaldehyde sulfuric acid reagent to obtain relevant information the contribution of single components to the overall heath-promoting effects
- LOD and LOQ for [6]-gingerol and [6]-shogaol via UV/Vis *versus* EDA detection
- Verification or characterization of active compounds via HPTLC-ESI$^+$/ESI$^-$-HRMS completes the overall picture on this effective botanical.

HPTLC-UV/Vis/FLD-EDA



Effect-directed assays

DPPH$^{\bullet}$: Radical-scavengers as light-yellow zones on purple background

A. fischeri : Gram-negative antimicrobials as dark zones on light-gray background (greyscale image of the bioluminescence)

B. subtilis: Gram-positive antimicrobials as white zones on a deep purple background

AChE inhibitors as whitish zones on light red-brown background

Tyrosinase inhibitors as light zones on gray back-ground

UV-active compounds

Derivatized compounds

with anisaldehyde sulfuric acid reagent at UV 366 nm

under white light illumination

Fig . 1 Profiling of of fresh ginger and ginger product extracts

Characterization via HRMS

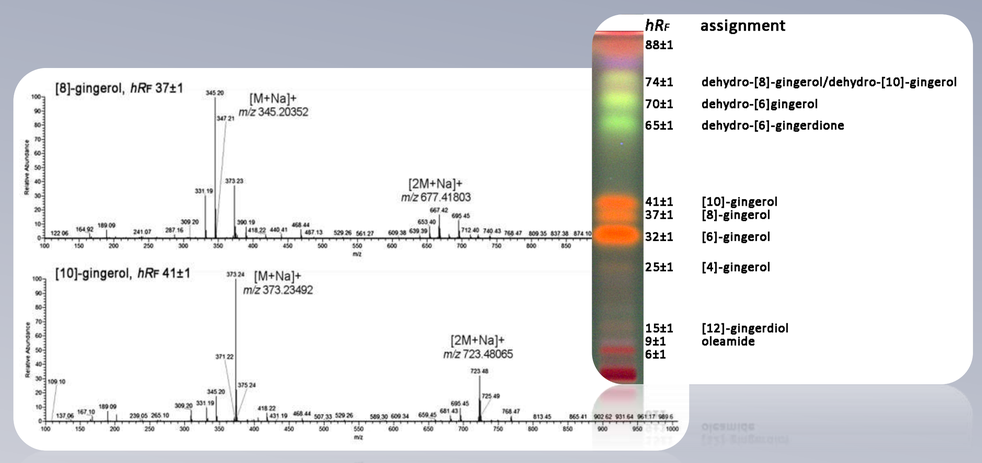


Fig. 2 Further characterization of two multi-potent gingerols using HPTLC-ESI$^+$-HRMS

Bioactive zones of interest were further analyzed via HPTLC-ESI-HRMS. Apart from the well known bioactive representatives of ginger's oleoresin fraction, [6]-gingerol and [6]-shogaol, other active compounds were assigned (Fig. 2):

The mass spectra of the zones at hR_F 37±1 and hR_F 41±1 showed the monosodium adducts of the respective monomers $[M+Na]^+$ and dimers $[2M+Na]^+$ assigned to be [8]-gingerol at *m/z* 345.20352 and 677.41803 as well as [10]-gingerol at *m/z* 373.23492 and 723.48065, respectively.

Samples and method developed

For profiling, fresh ginger with peel (Fig. 1, no. 1) and without (no. 2), dried ginger powder (not depicted), ginger teas (no. 3-5), if required ground in a mortar, were extracted with ethyl acetate (a), methanol - water 1:1 (b) and petoleum ether - *t*-butyl methyl ether 1:1 (c). Ginger ale (no. 6) and further ginger-containing beverages (not depicted) were extracted with *n*-hexane.

These extracts as well as standard mixture S (Fig. 1, 1.5 and 6.0 µL/band) were bandwise applied on HPTLC plates silica gel 60 F_{254} and separated with *n*-hexane - ethyl acetate 13:7. Multi-detection was performed via 5 different effect directed assays (Fig. 1, A-E) as well as at UV 254 nm (F) and after derivatization with anisaldehyde sulfuric acid reagent at UV 366 nm (G) and under white light illumination (H), with [6]-gingerol marked at *hR*F 32±1 and [6]-shogaol at *hR*F 71±1.

Literature [1] Krüger, S.; Bergin, A.; Morlock, G.E., Effect-directed analysis of ginger (*Zingiber officinalis*) and its food products, and quantification of bioactive compounds via high-performance thin-layer chromatography and mass spectrometry, in submission.

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