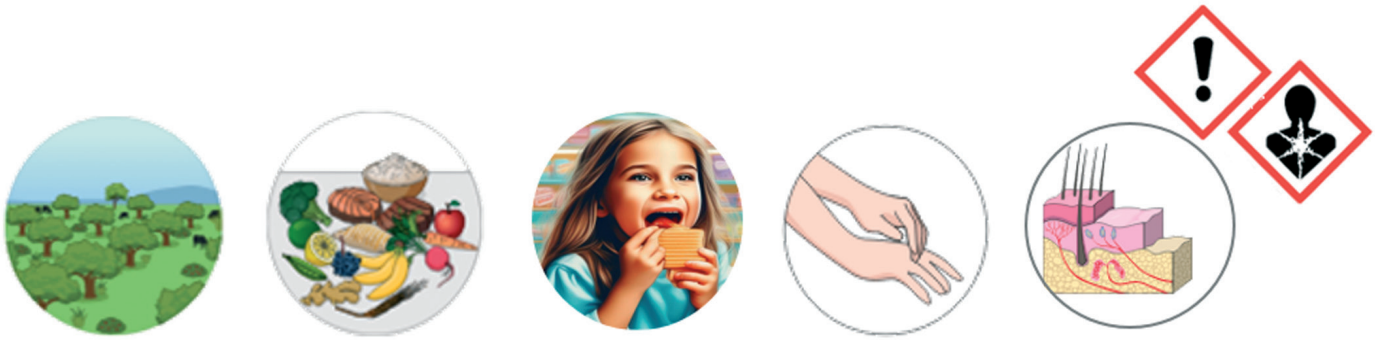

Sustainable lab future is now

2LabsToGo system

Prof. Dr. Gertrud Morlock

The portable 2LabsToGo system combines two fully equipped laboratories in an automated all-in-one system. It is a lean miniaturized analysis system, which saves resources and supports sustainability, method greenness and eco-friendliness.

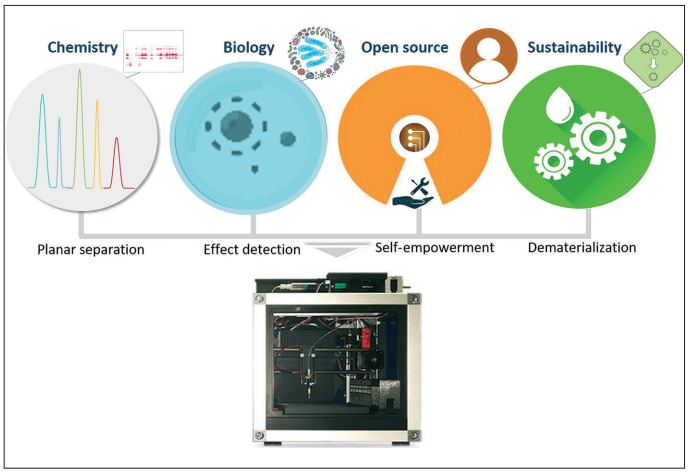

Fig. 1: Technologies combined in the portable 2LabsToGo system

The unique system combines technologies from four different disciplines (Fig. 1). It bridges chemistry (chromatographic separation) with biology/toxicology (biological effect detection), system development (open-source system engineering, 3D printing) and sustainability (dematerialization, saving resources). The compact 2LabsToGo system (8 kg, 31 cm x 26 cm x 34 cm) includes and performs all the relevant steps that are normally carried out in a chemistry and a biology laboratory [1, 2]. The combination of complementary technologies in the same analysis system resulted in a powerful yet affordable 2LabsToGo screening. The efficient prioritization on hazardous compounds in complex samples brings breakthrough insights and novel application benefits in changing markets. It is crucial for solving major challenges, such as providing clean water, healthy food or safe lifestyle products and identifying triggers of chronic diseases. For example, previously unknown hazardous compounds were detected in everyday foods, perfumes and cosmetics (Fig. 2, [3]).

Virtually no sample preparation was performed to keep the sample as intact as possible and to ensure high sample integrity. The raw sample extracts were automatically applied and separated on the adsorbent surface. The UV/Vis/FLD detection was performed automatedly using respective LEDs and the Raspberry Pi camera. Chemical derivatization reagents were piezoelectrically applied by a 3D-printed nebulizer, followed by heating using an integrated heating mat. For non-targeted effect detection, the bioassay suspensions/solutions were analogously applied, followed by on-surface incubation (on the same separation adsorbent) in a 3D-printed mini-incubator. Thus, information is obtained on any beneficial or hazardous compounds present in the complex sample mixtures (separated in parallel) and half maximal inhibition or effect concentration (IC50 or EC50) values can be calculated. For example, the system can be used for toxicological studies of chemicals required for REACH registrations [4–6]. Or, it can be used to screen non-targeted for hazards in products and by this, support a proactive food safety culture [7–9].

The instrumental functions as well as quantitative results obtained by this innovative technology have been shown to be comparable to those of conventional state-of-the-art instruments filling two laboratories [1, 2]. The material costs are around € 3600 for the latest model, making it affordable.

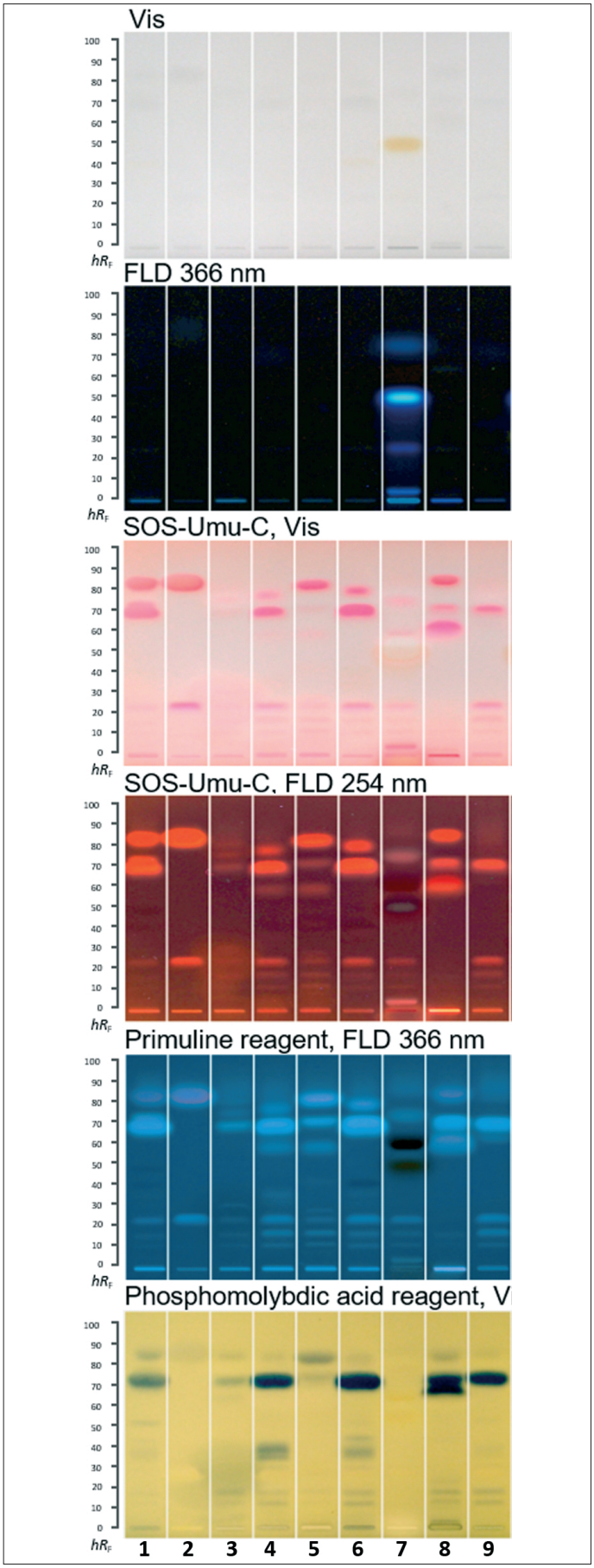

Fig. 2: Toxicological screening of nine different skin care creams with the planar genotoxicity bioassay (HPTLC–SOS-Umu-C–Vis/FLD), which detects genotoxins as rose colored or orange fluorescent compound zones; thereafter, the bioautogram was detected with a derivatization sequence of first primuline reagent and then phosphomolybdic acid reagent (multiple detection of the same analysis).

Fig. 3: The DIY workshop to build yourself your own open-source 2LabsToGo system

It can also be adapted and optimized to suit your own needs. The sustainable open-source do-it-yourself (DIY) system is built by yourself, which supports self-empowerment (Fig. 3).

Specialist knowledge of effect-directed planar assays is annually taught in a digital course (last February week, www.uni-giessen.de/food). Multicomponent mixtures are the topic of a respective initiative (www.vielstoffgemische.de) [10].

Acknowledgement

Thanks to Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr (grant E/U2AD/KA018/IF565) and Merck for support with HPTLC plates.

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