Sample Profiling

Importance and scope of Open-source 2Labs2Go system

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In the Office Chromatography (OC) concept, all steps of planar chromatography are miniaturized using new technologies [1]. Open-source developments are freely available, the source code is open and modifications of the device are possible.

During self-assembly, the user gains valuable troubleshooting and customization skills. Open-source hard- and software solutions come along with a steep learning curve, whereby basic knowledge on electronics, mechanics and programming is helpful. The initial approach was based on low-cost thermal inkjet printers that were slimmed down and slightly modified for operation in chromatography [1-3]. The following system generations (OCLab1/2 [4–6]) were based on open-source technologies and programmed in R but unfortunately not completely solvent compatible.

The latest OCLab3 (Fig. 1) was newly developed as a fully solvent-resistant open-source system operated via the OCManager3 software in Python to provide a convenient graphical user interface [7]. The codes of software, firmware and 3D print files for instrumental setup are freely available at https://github.com/ocmanager/OCManager3 and https://github.com/ocmanager/OCLab3. Recently, the chemical derivatization step, planar bioassay application and bioluminescence detection were successfully integrated [7]. The integrated biological detection made it the first open-source 2Labs2Go system, incorporating both the chemistry laboratory and biology laboratory. It is compact (26 cm x 31 cm x 34 cm), lightweight (6.8 kg), and affordable. Miniaturization of all planar chromatographic steps led to a lean all-in-one system and enhanced method greenness (eco-friendliness).

Food quality checks compared to status quo

Sample application, development, UV/Vis/FLD detection and biological luminescence imaging using the OCLab3 were recently shown for screening of water samples [7]. These were directly applied without the least sample preparation but sedimentation. The application of 40 µL of the sample is sufficient. For landfill leachate samples or biogas plant water, dark zones were observed. In contrast, for the wastewater treatment plant effluent or tap water samples, almost no zone was detected. The *A. fischeri* bioassay frequently used as *in vitro* "toxicity" assay in the environmental field was used for non-targeted detection, however, applied as planar on-surface bioassay. If there was almost no zone detected, it proved the water to be free of bioactive compounds which influenced the bacterial energy metabolism. This is typically the case for drinking water when 40 µL are applied and this volume can be used for water screening. Comparing the patterns or profiles, results are easily understood globally: no response (more pure water) is better than heavy response (contaminated water), evident as dark zones. [7] As further example, the separation of 20 Stevia extracts (double determination on opposing plate sides) was compared with the status quo (Fig. 2) [5]. It clearly shows the potential of the low-cost system.

OCLab3 as open-source 2Labs2Go system combines sample application, separation, imaging and biological effect detection (Fig. 3), which is important for prioritizing compounds among the many compounds in complex samples. The printing of the layer was already shown [6] to open new perspectives for layer materials and patterns and could be integrated in the future. However, also the performance of novel ultrathin layer developments can be analyzed by such 2Labs2Go system [1, 3]. On reduced layer thicknesses, reduced solvent volumes are needed for the separation or derivatization, which will make the method even more eco-friendly and attractive.

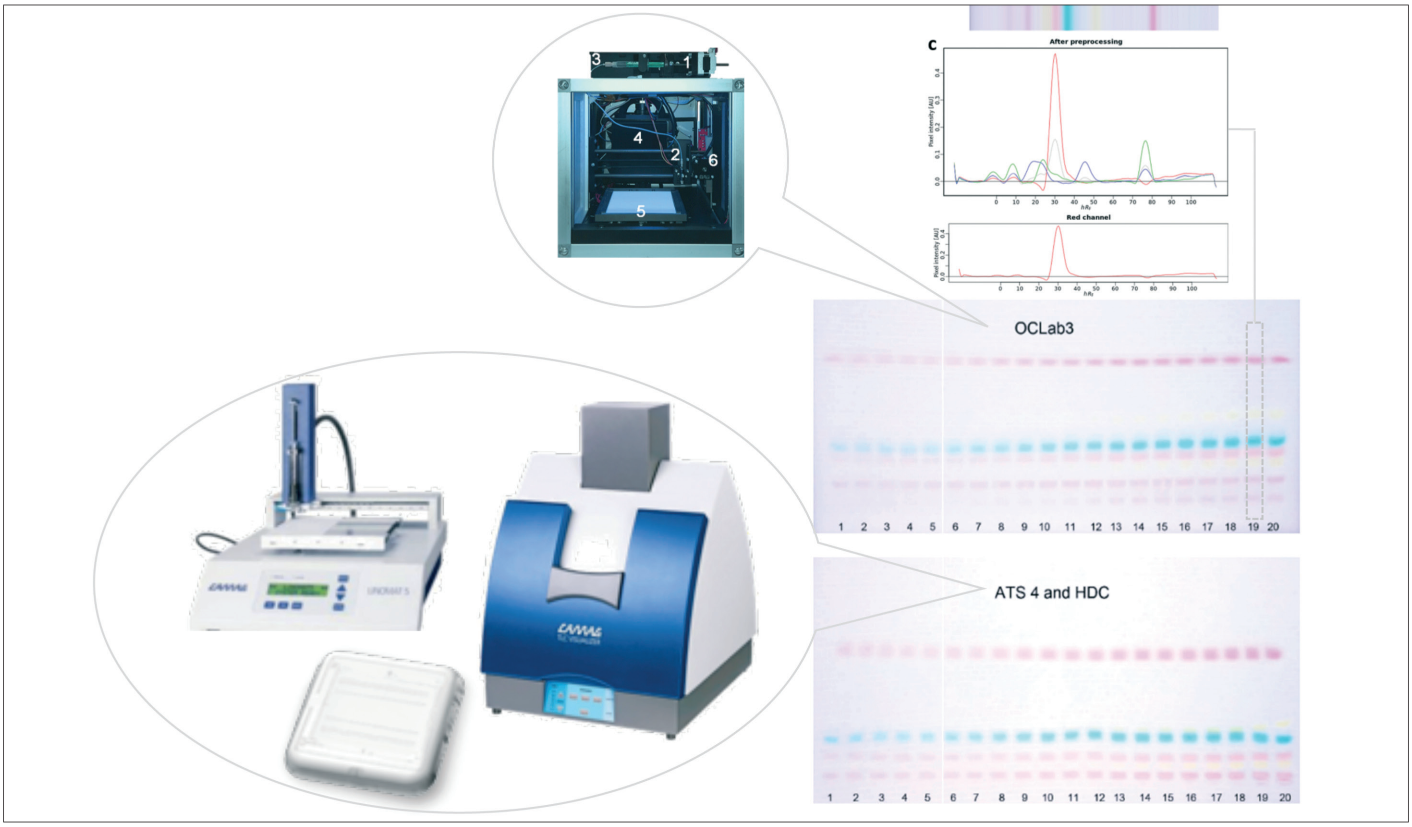

Fig. 1: 2Labs2Go system versus conventional system for sample analysis of food dyes.

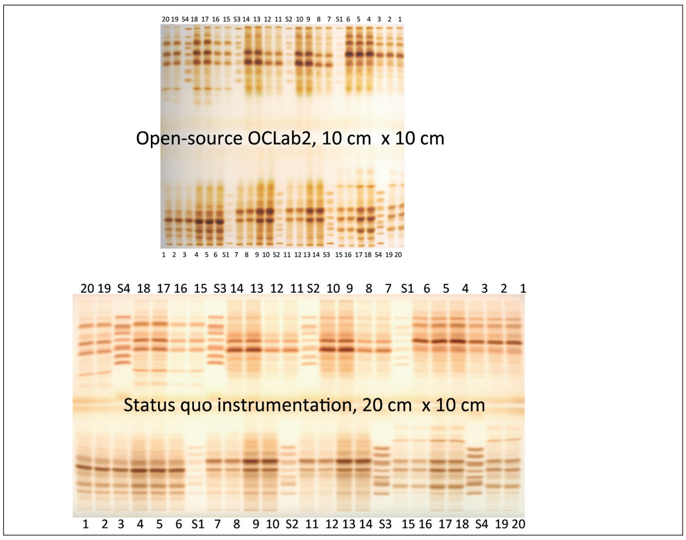

Fig. 2: Profiling of 20 Stevia extracts (double determination on opposing plate sides) using the OCLab versus conventional system. Modified according to [5], Copyright Elsevier, permission granted 2021

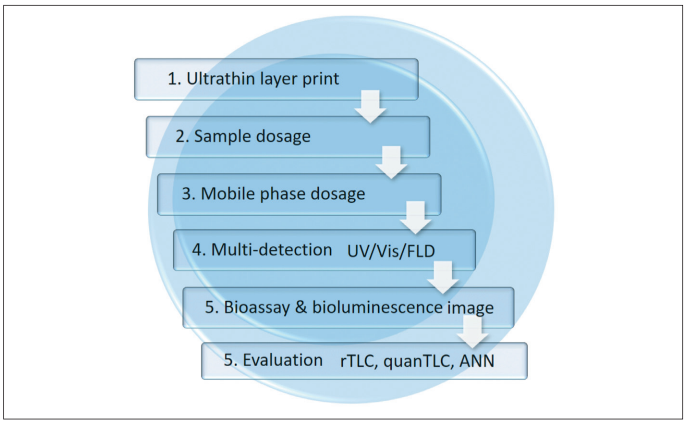

Fig. 3: Planar chromatographic steps altogether in an all-in-one system

Conclusions

As awareness on healthy food increases, so does citizens' interest in an easy-to-understand tool for checking food quality or other complex samples. An image is worth a thousand words – an effect-directed image even more. Artificial intelligence may assist in the future. By mapping and comparing patterns or profiles, results are understood across languages and globally. As for 3D printing, which became accessible to the public, we hope to inspire participation and to see that chromatography systems follow the same trend. As technology and software become available, citizens can engage in the community so that development becomes self-empowering.

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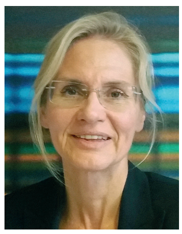

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