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ACTUALLY “VEGAN”? DETECTIVE WORK WITH THE PY-GC/MS

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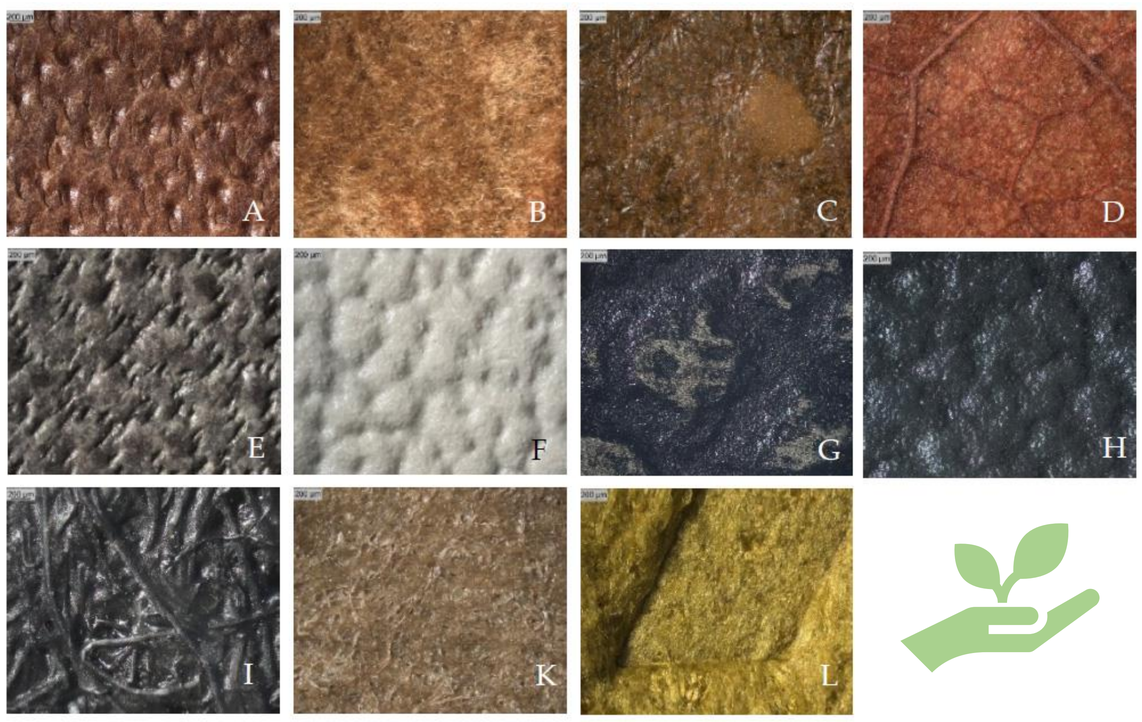
Introduction

Due to constant social criticism, general ecological change and political debates about increasing the use of renewable raw materials, the production of “vegan” leather alternatives has been greatly advanced in recent years. It is not uncommon to come across leather imitations made from e.g. pineapple fibers, apple scraps, banana fibers, eucalyptus fibers, cactus, cork, mushrooms, teak leaves and wine scraps. [1] To keep track of the variety of new, “vegan” materials is therefore tricky. How can it be proven that no animal raw materials were actually used?

Trendy leather alternatives



Materials: Naturally grown material (Leather (A), Muskin® (B), Kombucha (C), Teak Leaf® (D)); embossed surfaces of coated textiles (PUR-coated textile (E), Desserto® (F), Appleskin® (G), Vegea® (H)); fiber structures of non-woven natural fibers (Pinatex® (I), SnapPap® (K)), and micro-fiber material (Noani® (L), embossed). [1]

The market for biogenic and synthetic alternatives to leather is increasing aiming to replace animal-based materials with “vegan” alternatives. In parallel, bio-based raw materials should be used instead of fossil-based synthetic raw materials. [1]

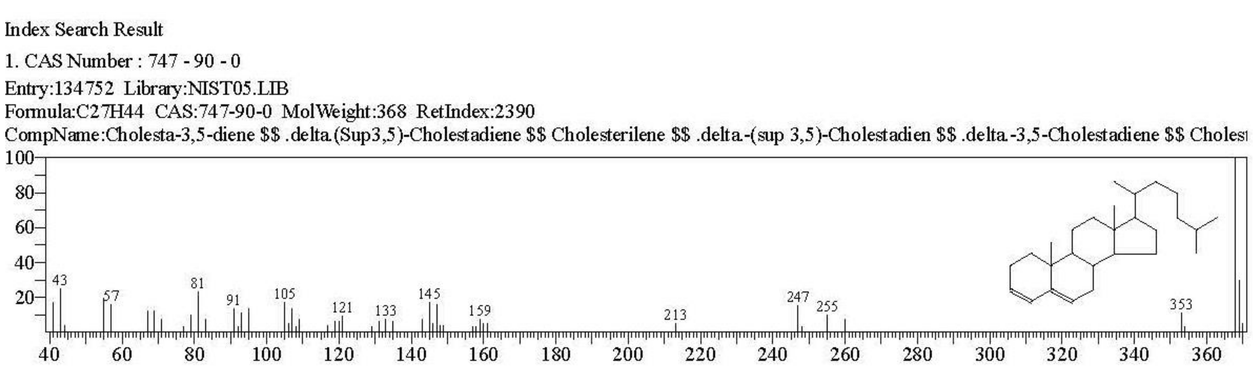
Therefore, it is tried to reduce the non-renewable content of artificial leather by replacing parts of the synthetic component polyvinylchloride (PVC) or polyurethane (PUR) of synthetic coatings with agricultural waste-derived products as filling material, such as grain, apple pomace (Vegea®, Appleskin®), or milled cactus leaves (Desserto®). Also fungi and symbiosis of bacteria and yeast are used to produce fibrous networks aiming to imitate the fibrous structure similar to an animal skin as single materials or as support for a coating layer. An other way is to use renewable fibers of pineapple leaves (Pinatex®) that are processed into non-woven support coated with polylactic acid (PLA) produced from corn starch. [1]

Analysis of leather alternatives with Py-GC/MS

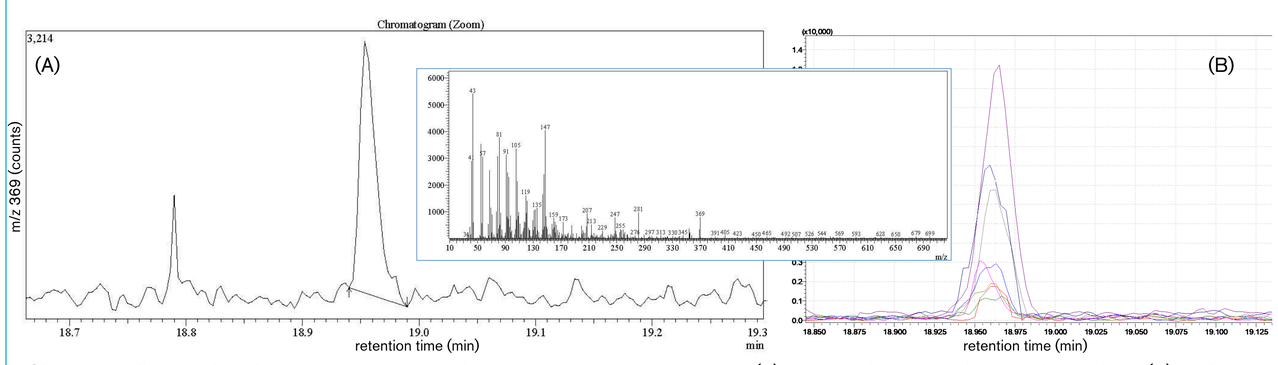
“Vegan” or not?

Cholesterol is a natural substance found in all eukaryotic cells and is therefore an essential component of all animal cell membranes. [3]

Numerous experiments at FILK have shown that cholesta-3,5-diene (a cholesterol derivative) is present in all conventional leathers. Cholesta-3,5-diene can therefore be used to identify animal ingredients in a material.

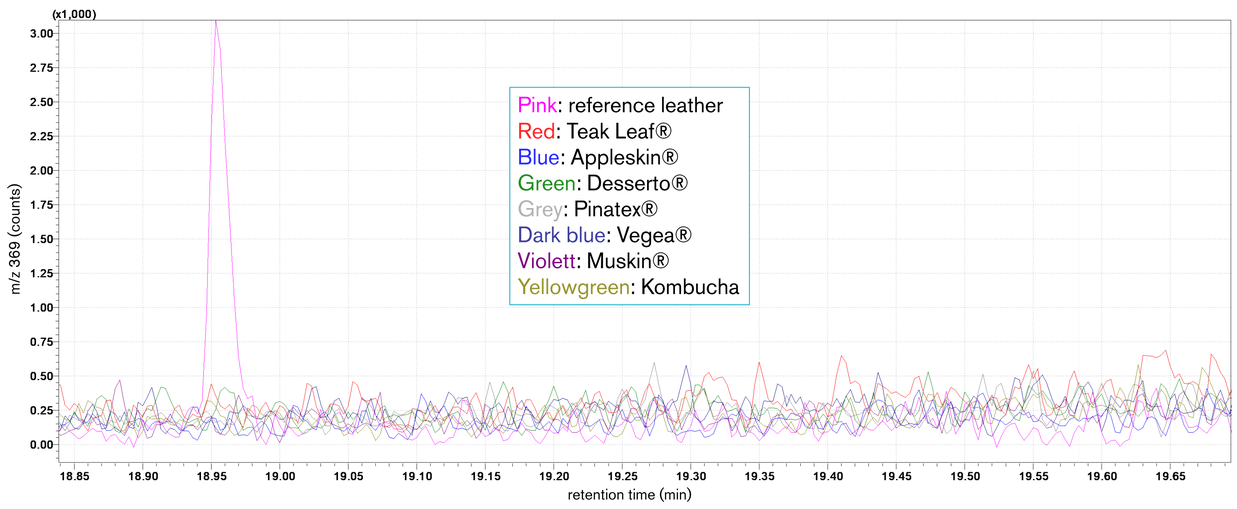


NIST 05 database entry of Cholsta-3,5-diene.

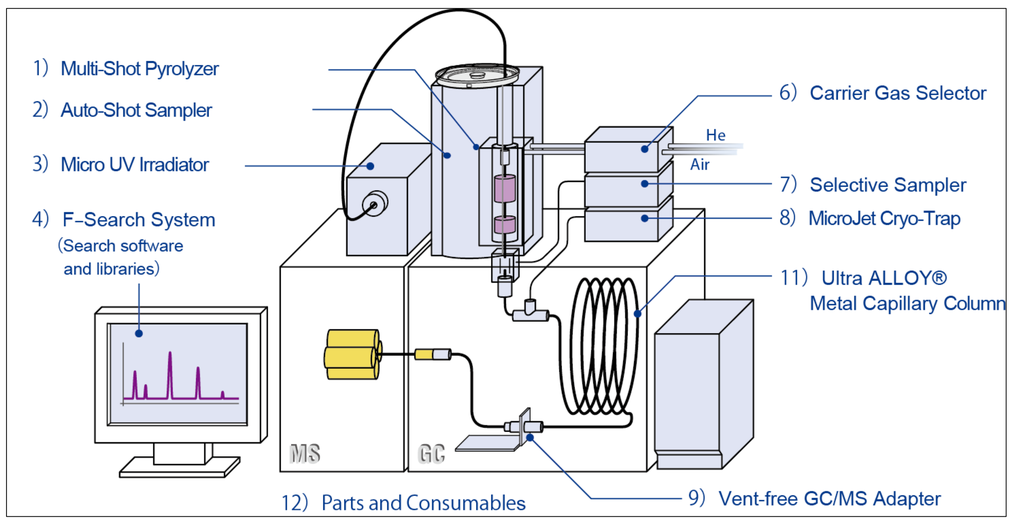


Cholsta-3,5-diene peak and mass spectra at a retention time of 18,953 min at m/z 369. (A) reference leather, made from a bovine hide. (B) 8 other leathers, made from different bovine hides with different retanning agents.

Conversely the absence of cholesta-3,5-diene is an indicator for “**vegan**” leather imitations.



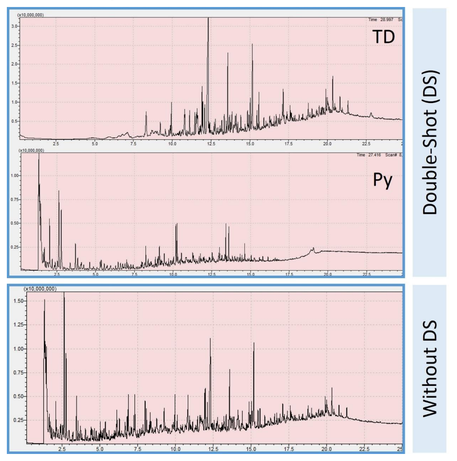
Py-GC/MS – a method for (almost) everything



Multi-Functional Pyrolysis System Configuration [2]. The modules 3), 6), 8) and 9) are not necessarily required.

Advantages of Py-GC/MS:

- user friendly, simple sample preparation without previous extraction
- applicable for lots of materials (e.g. leather, coated textiles, polymers)
- solid, insoluble and non-volatile samples can be analyzed
- high informative content because of the double-shot modus (detailed information about additives (volatiles) AND high molecular compounds (non-volatiles) in ONE analysis



Thermodesorption-phase (TD):

- Heating the sample using a temperature (gradient) up to approx. 350°C
- Analysis of volatile components using GC/MS

Pyrolysis-phase (Py):

- Thermal decomposition of the sample at a defined temperature (up to 800°C)
- Analysis of the fragments using GC/MS

Conclusion

“Vegan” materials are considered as sustainable and environmentally friendly. Through the targeted analysis of the materials, the consumer, trader and salesman can obtain information about the presence of animal components. However, there is no guarantee that the materials are completely “vegan”. Due to the technical production, the origin of fatty acids, for example, cannot be clearly traced.

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Literature:

[1] Meyer, M., Dietrich, S., Schulz, H., & Mondschein, A. (2021). Comparison of the technical performance of leather, artificial leather, and trendy alternatives. Coatings, 11(2), 226.

[2]] Frontier Laboratories Ltd. https://www.frontier-lab.com/products/multi-functional-pyrolysis-system/200599/. Accessed 21 March 2024.

[3] Li, L. H., Dutkiewicz, E. P., Huang, Y. C., Zhou, H. B., & Hsu, C. C. (2019). Analytical methods for cholesterol quantification. Journal of food and drug analysis, 27(2), 375-386.

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