ISSN 2786-7080 (Print)
ISSN 2786-7072 (Online)

УДК 343.982.32
https://doi.org/10.33994/kndise.2026.71.32

Zīle Aelita

PhD., Doctor of Social Sciences, Assistant Professor,
Faculty of Social Sciences,
Riga Stradins University
https://orcid.org/0000-0002-4378-738X
aelita.zile@rsu.lv

BIOLOGICAL POWDERS AS AN INNOVATIVE TECHNOLOGICAL SOLUTION FOR VISUALISING TRACES OF SWEAT AND FATTY SUBSTANCES

To cite this article: Zīle A. (2026). Biological powders as an innovative technological solution for visualising traces of sweat and fatty substances. *Criminalistics and Forensics, 71,* 499–510. doi: https://doi.org/10.33994/kndise.2026.71.32

The article highlights the theoretical and practical aspects of using biological powders as an innovative technological solution for detecting and visualising latent papillary pattern traces formed by sweat and fatty substances. The relevance of using environmentally safe means that are harmless to human health in forensic practice is considered. The results of foreign studies on the application of biological powders of plant and natural origin for detecting latent traces on various surfaces are analysed. **The aim of the study** is to identify new possibilities for visualising latent papillary pattern traces using commercial biological powders by evaluating their adhesive properties during the treatment of experimentally deposited traces on plastic, glass, and metal surfaces. **The methodological basis** of the study is the experimental examination of the adhesive properties of biological powders during the visualisation of latent papillary pattern traces. The article applies a comparative analysis of the results of previous foreign studies, an experimental method of depositing traces on trace-receiving surfaces, a powder dusting method using fibreglass brushes and Marabou feather brushes, as well as photographic recording of the results. To assess the effectiveness of the powders, the categories of good, moderate, and poor adhesive properties were used. **The scientific novelty** lies in the comprehensive study of the possibilities of applying commercial biological powders, in particular cinnamon, turmeric, paprika, onion, banana, blackcurrant, agar, spirulina, chlorella, guar gum, and xanthan gum powders, for vis-

ualising latent papillary pattern traces on plastic, glass, and metal surfaces. Particular attention is paid to the influence of particle size, colour contrast between the powder and the surface, and the method of powder application on the quality of trace visualisation. **The conclusions** emphasize that the use of biological powders for visualising latent papillary pattern traces is a promising direction in the development of forensic techniques. It has been established that the effectiveness of such powders depends on fine and uniform particle size, sufficient contrast with the surface, and the proper method of application. Spirulina, chlorella, cinnamon, and turmeric powders demonstrated the best adhesive properties. Further research should focus on studying the possibility of transferring visualised traces onto dactyloscopic film or silicone materials, as well as examining the preservation of traces under different time intervals, temperature conditions, and meteorological conditions.

Keywords: latent dactyloscopic traces, visualisation, biological powders, adhesion.

Зіле Аеліта

доктор соціологічних наук, доцент факультету
соціальних наук Ризького університету імені Страдіня,
Рига, Латвія
https://orcid.org/0000-0002-4378-738X
aelita.zile@rsu.lv

БІОЛОГІЧНІ ПОРОШКИ ЯК ІННОВАЦІЙНЕ ТЕХНОЛОГІЧНЕ РІШЕННЯ ДЛЯ ВІЗУАЛІЗАЦІЇ ПОТОВО-ЖИРОВИХ СЛІДІВ

Бібліографічний опис статті: Зіле, А. (2026). Біологічні порошки як інноваційне технологічне рішення для візуалізації потово-жирових слідів. Криміналістика та судова експертиза, 71, 499–510. doi: https://doi.org/10.33994/kndise.2026.71.32

Стаття висвітлює теоретичні та практичні аспекти застосування біологічних порошків як інноваційного технологічного рішення для виявлення та візуалізації латентних слідів папілярних узорів, утворених потожировими речовинами. Розглянуто актуальність використання екологічно безпечних і нешкідливих для здоров'я людини засобів у криміналістичній практиці. Проаналізовано результати зарубіжних досліджень щодо застосування біологічних порошків рослинного та природного походження для виявлення латентних слідів на різних поверхнях. Метою дослідження є визначення нових можливостей візуалізації латентних слідів папілярних узорів із використанням комерційних біологічних порошків шляхом оцінювання їх адгезійних властивостей під час обробки експериментально

ISSN 2786-7080 (Print)
ISSN 2786-7072 (Online)

залишених слідів на пластикових, скляних і металевих поверхнях. Методологічну основу дослідження становить експериментальне вивчення адгезійних властивостей біологічних порошків під час візуалізації латентних слідів папілярних узорів. У статті застосовано порівняльний аналіз результатів попередніх зарубіжних досліджень, експериментальний метод нанесення слідів на слідосприймальні поверхні, метод порошкового оброблення слідів із використанням скловолоконних пензлів і пензлів із пера марабу, а також фотографічну фіксацію результатів. Для оцінювання ефективності порошків використано категорії добрих, помірних і слабких адгезійних властивостей. Наукова новизна полягає у комплексному дослідженні можливостей застосування комерційних біологічних порошків, зокрема порошків кориці, куркуми, паприки, цибулі, банана, чорної смородини, агару, спіруліни, хлорели, гуарової та ксантанової камеді, для візуалізації латентних слідів папілярних узорів на пластикових, скляних і металевих поверхнях. Особливу увагу приділено впливу розміру частинок, кольорового контрасту між порошком і поверхнею, а також способу нанесення порошку на якість візуалізації сліду. У висновках підкреслюється, що використання біологічних порошків для візуалізації латентних слідів папілярних узорів є перспективним напрямом розвитку криміналістичної техніки. Встановлено, що ефективність таких порошків залежить від дрібного та однорідного розміру частинок, достатнього контрасту з поверхнею та правильного способу нанесення. Найкращі адгезійні властивості продемонстрували порошки спіруліни, хлорели, кориці та куркуми. Подальші дослідження доцільно спрямувати на вивчення можливості перенесення візуалізованих слідів на дактилоскопічну плівку або силіконові матеріали, а також на дослідження збереження слідів за різних часових, температурних і метеорологічних умов.

Ключові слова: латентні дактилоскопічні сліди, візуалізація, біологічні порошки, адгезія.

Problem Statement

In a rapidly changing world, the issue of ecosystem conservation and preservation for future generations is becoming increasingly crucial. This encompasses a wide range of fields, affecting not only the development of zero-waste and renewable resource technologies but also having a direct impact on the health and quality of life of both current and future generations.

In forensic science, the possibilities of applying innovative technologies that are harmless to the ecosystem and human health in the detection of physical evidence are also being explored. One of the directions in this field is the visualisation of latent papillae pattern prints at crime scenes using various biological powders.

Analysis of Recent Studies and Publications

Within studies conducted abroad, experiments have been carried out by using various biological powders to visualise latent papillae pattern prints, such as turmeric [11, 17, 1, 13], onion [18], banana peel [19], spirulina [15], Uncaria gambir [14], tulsi (Ocimum tenuiflorum) [4], spinach [23], Lodhra (Symplocos racemosa) [21], rice bran [10], Liquorice (Glycyrrhiza glabra) [20], Dragon fruit (Hylocereus undatus) [12], Shikakai (Acacia concinna) [9], buckwheat flour [6], pomegranate peel [2], Durian [16], green and black tea leaves [3], Ashwagandha (Withania somnifera) [8], salt and sugar [7], Abies Webbiana (Thalisapathri) [5], Citrus Fruits [22].

Both commercially produced and researcher-prepared biological powders were used in the experiments. It should be noted that the powders applied in the experiments also cover a wide geographical range, and their preparation processes differ in terms of complexity, time required, and the technologies employed. However, their application in the visualisation of latent papillae pattern prints on various surfaces can be evaluated positively.

Objective of the Study

To identify new possibilities for visualisation of latent papillae pattern prints using commercial biological powders, by evaluating their adhesive properties when visualising experimentally deposited papillae pattern prints on plastic, glass, and metal surfaces.

Methodology. A total of 22 plastic (11 white and 11 black), 22 glass (11 white and 11 black), and 22 metal (11 grey and 11 black) objects were used as trace-perceiving objects of latent papillae pattern prints. Five latent papillae pattern prints were deposited on each object, maintaining a short interval to allow the natural regeneration of sweat and fatty substances on the papillary lines, thereby preventing the depletion of these substances.

Biological powders of guar gum and xanthan gum, cinnamon, turmeric, paprika, onion, banana, blackcurrant, agar, spirulina, and chlorella biological powders were used with the particle size specified by the manufacturer to visualise the latent papillae pattern prints experimentally deposited on plastic, glass, and metal surfaces. Fiberglass brushes and Marabou feather brushes were used to dust the traces with powder. The results of the experiment were photographed.

Overview of Main Materials

During the experiment, biological powders previously used in foreign studies were applied, such as turmeric [11, 17, 1, 13], onion [18], and spirulina [15], analysing and comparing the adhesive properties of these powders with the observations and results obtained during the author's

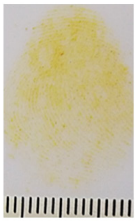
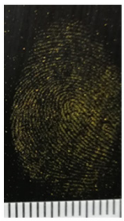
ISSN 2786-7080 (Print)
ISSN 2786-7072 (Online)

experiment. In addition, new biological powders were used during the experiment to visualise latent papillae pattern prints.

Table 1. Papillae pattern prints visualised by using cinnamon powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
					

Table 2. Papillae pattern prints visualised by using turmeric powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
					

Biological cinnamon and turmeric powders demonstrated good adhesive properties. However, during the experiment, it was observed that the powders did not adhere well to the Marabou feather brush, which did not provide a sufficient amount of powder for visualising the traces. Additionally, when mechanically applying the powder onto the trace, some of the powder that had already been applied was partially wiped away, which in turn endangered the preservation of the trace. Therefore, a different powder application method was used. Specifically, the powder was applied with a fiberglass brush, to which the powder adhered much better. The trace was dusted with the powder using circular motions, and then the excess powder was removed with light sweeping motions using a Marabou feather brush. Therefore, this method of powder application was used throughout the experiment.

This could be explained by the amount of sweat and fatty substances present in the trace, since such a situation was not described in the foreign experiments using turmeric powder. This may be due to the fact, that in those cases, the trace contained a greater amount of sweat and fatty substances, which also contributed to better adhesive properties of the powder.

Table 3. Papillae pattern prints visualised by using paprika powder

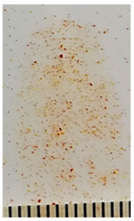
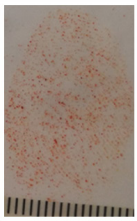
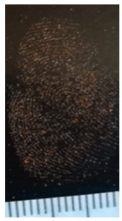
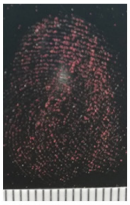
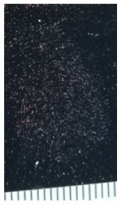
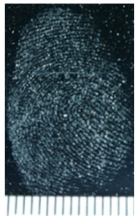
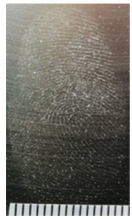
Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
					

Table 4. Papillae pattern prints visualised by using blackcurrant powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
					

When visualising traces using paprika and blackcurrant powder, it was found that the uneven granularity of the powder (i.e., the presence of both larger and smaller particles) affected the visualisation of the trace. Therefore, it was concluded that the use of paprika and blackcurrant powders requires a uniform particle size.

Table 5. Papillae pattern prints visualised by using agar powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
N		N			

ISSN 2786-7080 (Print)
ISSN 2786-7072 (Online)

Table 6. Papillae pattern prints visualised by using guar gum powder

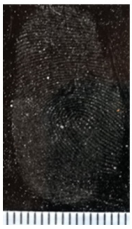
Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
N		N			

Table 7. Papillae pattern prints visualised by using onion powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
N		N			

Table 8. Papillae pattern prints visualised by using xanthan gum powder

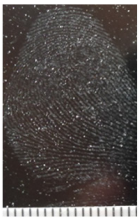
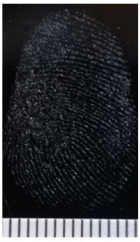
Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
N		N			

Table 9. Papillae pattern prints visualised by using banana powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
N		N			

Due to their colour, which did not provide sufficient contrast with the white trace-perceiving surfaces, agar, onion, guar and xanthan gum, and banana powders were not applied to the traces. Therefore, they are marked with “N” in the tables. Observations made during the experiment led to the conclusion that, among the powders mentioned, onion powder demonstrated the best adhesive properties (in comparison), although the adhesive properties of the other powders were not poor.

Table 10. Papillae pattern prints visualised by using spirulina powder

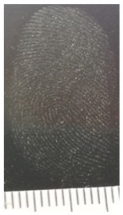
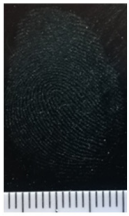
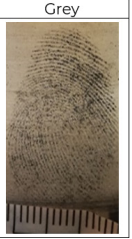
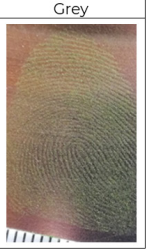
Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
					

Table 11. Papillae pattern prints visualised by using chlorella powder

Glass		Plastic		Metal	
White	Black	White	Black	Black-coloured	Grey
					

Spirulina and chlorella powders demonstrated very good adhesive

ISSN 2786-7080 (Print)
ISSN 2786-7072 (Online)

properties on practically all surfaces. Naturally, the better visualisation of the traces was observed when there was a contrast between the colour of the trace-perceiving object and the powder, which also applies to the use of other powders.

Based on the experimental results, the adhesive properties of the biological powders were evaluated in three categories:

A – good adhesive properties (clear trace visualisation);

B – moderate adhesive properties (the trace is indistinct);

C – poor adhesive properties (the powder practically does not adhere to or colour the trace).

Meanwhile, "N" was used to mark those object surfaces that were not treated with a particular powder due to its colour, as the powder did not provide sufficient contrast with the colour of the trace-perceiving object.

Table 12. Evaluation of the Adhesive Properties of Biological Powders

Powder	Evaluation of the adhesive properties of biological powders based on the results of the experiment					
	Glass		Plastic		Metal	
	White	Black	White	Black	Grey	Coloured, black
Cinnamon	A	A	A	A	A	A
Turmeric	B	A	B	A	A	A
Paprika	C	B	C	C	B	B
Blackcurrant	C	B	B	C	B	B
Agar	N	A	N	A	A	A
Guar gum	N	A	N	A	A	A
Onion	N	A	N	A	A	A
Xanthan gum	N	A	N	A	A	A
Banana	N	A	N	A	A	A
Spirulina	A	A	A	A	A	A
Chlorella	A	A	A	A	A	A

Conclusions

The results obtained during the experiment allow one to conclude that the visualisation of latent papillae pattern prints using biological powders is possible, but only under the following conditions.

First, the powders must have a fine and uniform grain size. This means that commercial powders cannot always be used without additional grinding to achieve a uniform grain size.

Second, it is preferable for the colour of the powder to contrast with the colour of the trace-perceiving surface, unless the visualised trace is transferred onto silicone casting material or dactyloscopic film.

Third, it is recommended for visualisation of a trace to dust it with powder and then remove excess powder by using slight sweeping motions.

As a result of the experiment, the author concluded that further study into the practical application of biological powders for the visualisation of latent papillae pattern prints should continue by conducting:

– lifting the visualised traces onto silicone casting material or dactyloscopic film, which could expand the range of applicable powders, for example in cases of low contrast between the powder and the trace-perceiving surface;

– visualising traces after different time intervals, for example after 24, 48, and 72 hours;

– visualising traces after exposure to low, high, and fluctuating temperatures over time intervals such as 24, 48, and 72 hours, as well as after exposure to variable meteorological conditions.

This outlines the author's next stages of the experiment in the visualisation of latent papillae pattern prints using biological powders.

References:

1. Alex A., Arthanari A., Rajeshkumar S. (2021). A technique for visualisation of latent fingerprints turmeric (*Curcuma aromatica*) powder on walls and floor. *Drugs and Cell Therapies in Hematology*, 10(2), 282–290 [in English].

2. Darshan R.S., Sharma V., Sharma A., Rai A.R., Kumari P., Gautam A., Singh A., Mishra V., Awasthi K.K., Sankhla M.S. (2025). Pomegranate peel powder: an effective and environmentally friendly tool for developing latent fingerprints on nonporous surfaces. *Journal of Forensic Science and Medicine*, 11(1), 38–44. DOI: https://doi.org/10.4103/jfsm.jfsm_103_23 [in English].

3. Dwivedi R., Kothari H., Saxena G., Thakre V., Jangir B. (2026). Green synthesis of eco-friendly fingerprint powders from brewed green and black tea leaves. *International Journal of Research and Review*, 13(2), 1–19. DOI: https://doi.org/10.52403/ijrr.20260210 [in English].

4. Hariprasath T.K., Arthanari A., Rajeshkumar S. (2021). *Ocimum sanctum* powder as a dusting material in latent fingerprints: an observational study in forensic. *Drugs and Cell Therapies in Hematology*,

10(2), 388–396 [in English].

5. Kannan S., Arthanari A., Rajeshkumar S. (2021). *Abies webbiana* (Thalisapathri): latent fingerprint method on various surfaces: an innovative technique. *Drugs and Cell Therapies in Hematology*, 10(2), 500–506 [in English].

6. Kumari P., Godara V., Lohar S., Singhal A., Nagar V., Aseri V., Prajapati M.K., Rai A.R., Singh A., Awasthi K.K., Singh G.K., Sankhla M.S. (2025). Enhancing latent fingerprint development with buckwheat flour (Kuttu Aata): exploring a promising natural material for forensic investigations. *Letters in Applied NanoBioScience*, 14(1), 1–8. DOI: https://doi.org/10.33263/LIANBS141.046 [in English].

7. Mia R., Panchal V., Gokhale C. (2021). Using salt and sugar powder to development hidden fingerprint impressions at the crime scene. *International Journal of Forensic Sciences*, 6(2), 1–5. DOI: https://doi.org/10.23880/ijfsc-16000232 [in English].

8. Rai A.R., Sharma V., Jain D., Kaur A., Agrawal M., Kanoujiya V., Nagar V., Kumari P., Awasthi K.K., Verma R.K., Sankhla M.S. (2025). Exploring the forensic potential of ashwagandha (*Withania somnifera*) powder: a novel approach for enhancing latent fingerprint development. *Letters in Applied NanoBioScience*, 14(1), 1–9. DOI: https://doi.org/10.33263/LIANBS141.041 [in English].

9. Rajalakshmi S., Sabu S. (2025). Green fingerprints: unveiling latent fingerprints using commercial shikakai powder. *International Journal of Scientific Research in Science and Technology*, 12(2), 897–901. DOI: https://doi.org/10.32628/IJSRST251222641 [in English].

10. Rajan R., Zakaria Y., Shamsuddin S., Hassan N.F.N. (2019). Fluorescent variant of silica nanoparticle powder synthesised from rice husk for latent fingerprint development. *Egyptian Journal of Forensic Sciences*, 9(50), 1–9. DOI: https://doi.org/10.1186/s41935-019-0155-1 [in English].

11. Garg R.K., Kumari H., Kaur R. (2011). A new technique for visualization of latent fingerprints on various surfaces using powder from turmeric: a rhizomatous herbaceous plant (*Curcuma longa*). *Egyptian Journal of Forensic Sciences*, 1, 53–57 [in English].

12. Sari S.A., Lubis A.N.S. (2021). The development of dusting method for dragon fruit peel as fingerprint visualization. *Jurnal Kimia dan Pendidikan Kimia*, 6(1), 1–13. DOI: https://doi.org/10.20961/jkpk.v6i1.46315 [in English].

13. Sari S.A., Jasmidi, Kembaren A., Ilmi A.N. (2019). Development of eco-friendly fingerprint visualization using herb. *Asian Journal of Chemistry*, 31(11), 2601–2606. DOI: https://doi.org/10.14233/ajchem.2019.22218 [in English].

14. Sari S.A., Ningsih H., Jasmidi, Kembaren A., Mahat N.M. (2019). Development of gambir powder as a cheap and green fingerprint powder for forensic applications. Proceedings of the 2nd International Conference on Biosciences and Medical Engineering (ICBME 2019). *AIP Conference Proceedings*, 2155, 020023-1–020023-5. DOI: https://doi.org/10.1063/1.5125527 [in English].

15. Sasipriya G., Arthanari A., Rajeshkumar S. (2021). A technique for visualisation of latent fingerprint using spirulina powder on electron-

ic surfaces. *Drugs and Cell Therapies in Hematology*, 10(2), 492–499 [in English].

16. Sekar M., Zulkifli N.F. (2017). Fingerprint powder from durian seeds: a green and effective approach in crime scene. *Indo American Journal of Pharmaceutical Sciences*, 4(8), 1–6. DOI: https://doi.org/10.5281/zenodo.845385 [in English].

17. Sharen A.A., Arthanari A., Rajeshkumar S. (2021). A technique for visualization of latent fingerprints using *Curcuma longa* (turmeric) on electronic surfaces. *Drugs and Cell Therapies in Hematology*, 10(2), 271–281 [in English].

18. Sharma A., Sharma V., Soy A., Gautam A., Sharma T., Awasthi K.K., Kumar R., Sankhla M.S. (2024). A novel approach to latent fingerprint development using onion (*Allium cepa*) powder. *Current Forensic Science*. DOI: https://doi.org/10.2174/0126664844349096250305062318 [in English].

19. Mopoung S., Thongcharoen P. (2009). Coloured intensity enhancement of latent fingerprint powder obtained from banana peel activated carbon with methylene blue. *Scientific Research and Essay*, 4(1), 8–12 [in English].

20. Surya C., Arthanari A., Rajeshkumar S. (2021). A new technique for visualization of latent fingerprint using Athimadhuram (*Glycyrrhiza glabra*). *Drugs and Cell Therapies in Hematology*, 10(2), 253–259 [in English].

21. Vabushana V.J., Arthanari A., Rajeshkumar S. (2021). A new technique for visualisation of latent fingerprints in walls, floors and doors using Lodhra bark (*Symplocos racemosa*). *Drugs and Cell Therapies in Hematology*, 10(2), 243–252 [in English].

22. Vakil S., Rohatgi S., Kumar S. (2024). Visualisation and enhancement of latent fingerprints using citrus fruits (*Citrus limon* powder). *International Journal for Multidisciplinary Research*, 6(3), 1–4 [in English].

23. Yadav S., Sharma N., Sharma S., Gnaneswari M.D. (2020). Exploring the potential of using spinach powder for the visualization of latent fingerprints. *Indian Journal of Natural Sciences*, 10(60), 19477–19483 [in English].

Надійшла до редакції / Received: 17.04.2026
Отримана після доопрацювання / Received after revision: 24.04.2026
Прийнято до друку / Accepted for publication: 28.04.2026
Опубліковано / Published: 29.05.2026

Фінансування: відсутнє / Funding: none.
Конфлікт інтересів: автор(и) заявляє(ють) про відсутність конфлікту інтересів / Conflict of interest: the author(s) declare no conflict of interest.
Дотримання етичних норм: дослідження виконано з дотриманням принципів академічної доброчесності / Ethical compliance: the study was conducted in accordance with the principles of academic integrity.
Дані дослідження: усі дані, необхідні для обґрунтування висновків, наведено у статті / Research data: all data necessary to substantiate the conclusions are presented in the article.