



# COMPARISON OF FINGERPRINT CHEMICAL ENHANCEMENT SEQUENCES ON PHYSICAL DEVELOPER QUALITY

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## Introduction

- Fingerprints are more unique than DNA.
- Eccrine sweat glands are numerous on hands and deposit eccrine sweat on a surface when the hand touches it.

Table 1: Compounds found in eccrine sweat.

Inorganic	Organic
Chlorides	Amino acids
Metal ions	Urea
Sulfates	Uric acid, Lactic acid
Phosphates	Sugars
Ammonia	Creatinine
Water (>98%)	Choline

- Indanedione-Zinc & DFO & Ninhydrin react with amino acids.

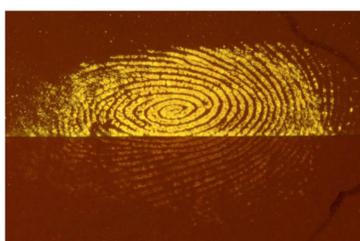


Figure 2: Shows IND-Zn & DFO fluorescing, on the top part is IND-Zn and on the bottom is DFO fluorescing.



Figure 3: Shows a fingerprint developed with ninhydrin producing the Ruhemann's purple color.

- Physical developer reacts with chlorides.



Figure 4: Shows the physical developer depositing black silver particles on a latent fingerprint.

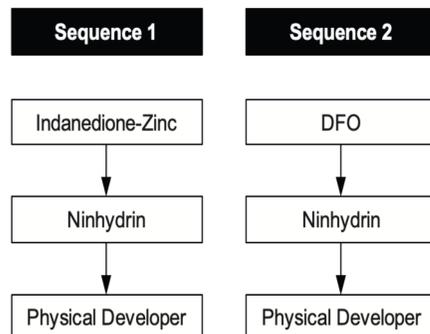


Figure 5: Shows two pathways for enhancing fingerprints on porous surfaces.

- When a fingerprint is exposed to water, the amino acids deteriorate but the physical developer reacts with insoluble compounds in eccrine sweat.
- The objective of this project was to determine which sequence has a greater enhancing affect on the physical developer.

## Methods

- Google scholar and science direct were used to find peer reviewed articles.
- The peer-reviewed articles were refined using key words, and the methodology of the tests ran on a fingerprint.
- Government papers were used to look at how each test ran in a specific methodology is used in the forensic field today.

## Results

- Each one of the fingerprints was collected naturally from 18 people with different ethnicity and physiological sex.
- Home office (HO) rating scale shows the quality of the fingerprint the higher the number the better it developed.
- University of Canberra (UC) rating scale observes finite changes a chemical continues to have after being ran through a previous chemical test.
- Both sequences 1 and 2 were ran at two locations so that the chemical enhancement tests would have different surrounding variabilities.

Table 2: Shows 4 different chemical enhancement tests ran with two different measuring systems to show which tests were enhanced from previously ran tests.

Age	Reagent	Avg. UC score	Avg. HO score	
			Sequence 1	Sequence 2
2 weeks	IND-Zn or DFO	0.55	2.60	2.16
	Ninhydrin	-0.24	1.08	1.30
	PD	-0.05	0.06	0.11
	Overall sequence	0.08	1.24	1.19
1 month	IND-Zn or DFO	0.64	2.74	2.33
	Ninhydrin	-0.08	1.56	1.62
	PD	-0.05	0.09	0.13
	Overall sequence	0.17	1.46	1.36
3 months	IND-Zn or DFO	0.30	2.88	2.60
	Ninhydrin	-0.28	1.58	1.83
	PD	-0.07	0.37	0.41
	Overall sequence	-0.01	1.61	1.62
All ages combined	IND-Zn or DFO	0.50	2.74	2.36
	Ninhydrin	-0.20	1.41	1.58
	PD	-0.06	0.17	0.22
	Overall sequence	0.08	1.44	1.39

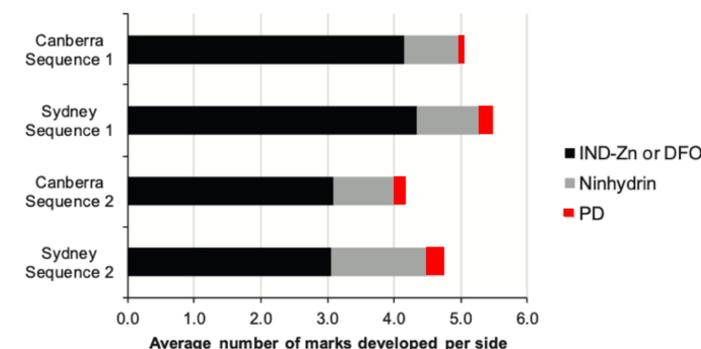


Figure 6: Shows the interpretation of table 2 data.

## Conclusion

- The physical developer process, responds better to sequence 2.
- Sequence 2 shows that the physical developer scores an average of 0.05 more on the HO scale versus sequence 1.
- This change is small but it does support that on some level previous chemical enhancement tests affect the physical developer.
- As the print ages the Physical developer process develops more fingermarks and minute points.

## References

1. D'Elia, V.; Materazzi, S.; Iuliano, G.; Niola, L. Evaluation and Comparison of 1,2-Indanedione and 1,8-Diazafluoren-9-One Solutions for the Enhancement of Latent Fingerprints on Porous Surfaces. *Forensic Sci. Int.* 2015, 254, 205–214.
2. M'arriott, C.; Lee, R.; Wilkes, Z.; Comber, B.; Spindler, X.; Roux, C.; Lennard, C. Evaluation of Fingerprint Detection Sequences on Paper Substrates. *Forensic Sci. Int.* 2014, 236, 30–37.
3. Sodhi, G. S.; Kaur, J. Physical Developer Method for Detection of Latent Fingerprints: A Review. *Egypt. J. Forensic Sci.* 2016, 6 (2), 44–47.
4. Trozzi, T. A.; Schwartz, R. L.; Hollars, M. L. <https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/jan2001/lpu.pdf>.
5. Sodhi, G. S.; Kaur, J. Physical Developer Method for Detection of Latent Fingerprints: A Review. *Egypt. J. Forensic Sci.* 2016, 6 (2), 44–47.

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