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# Latent Fingerprints by a Superior Ninhydrin Method

The ninhydrin method of latent fingerprint development is useful, reliable, and widely accepted [*1–3*]. This method chemically visualizes protein and amino acid materials, which have been deposited by the friction ridges of the skin, to form a nonvolatile, rather permanent impression.

Numerous variations of the ninhydrin development technique have appeared in the literature, and a few of the more common formulations are listed in Table 1. In an effort to identify and utilize the "best" general visualization technique, a number of these and other formulations were employed in our laboratory. Both known and unknown specimens were tested with results varying in intensity and detail. A technique [*4*] is described below which utilizes ninhydrin under mild conditions and yields superior results in visualizing latent fingerprints on paper.

## Materials and Methods

Ninhydrin (triketohydrindene hydrate), certified, and acetone, American Chemical Society (ACS) certified, were supplied by Fisher Scientific Co., Fair Lawn, N.J. and were used as received. All other chemicals were reagent grade and were used as received. Distilled water was used whenever water was required.

A Fisher Isotemp® oven, Junior Model, was used in the development procedures. When a saturated atmosphere was necessary, an aluminum tray (4 by 11 by 1 in.) was filled with tap water and placed in the lower rack of the oven; the oven was allowed to equilibrate for 15 min.

Test specimens were supplied by five laboratory members who each handled a given piece of paper in turn. This method was used randomly, producing what appeared to be uniform sets of prints when visualized by any one method.

Each of the formulations in Table 1 was employed by spraying a specimen (in an exhaust hood) with the appropriate solution and developing the prints, usually in a dry oven between 100° and 120°C, for a period of from 5 to 30 min.

The reagent of choice [*4*] was prepared by dissolving 1.0 g of ninhydrin in a solution of 100 ml of acetone, 3% water. This solution was sprayed (in an exhaust hood) at the rate of about 0.01 ml per 1 $cm^2$ of paper, or 6 ml per 8½ by 11-in. sheet of paper, upon the specimen to be visualized. The specimen was then placed in an oven and held at 60°C, with the atmosphere saturated with water vapor. The prints were allowed to develop under these conditions for 30 min and the paper was then removed and viewed.

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TABLE 1—*Various ninhydrin solutions applicable to the visualization of fingerprints.*

| Spray Solution | Conditions | Ref | Glycine, μg/spot | | | Fingerprint Quality |
|---|---|---|---|---|---|---|
| | | | 20 | 7 | 1.5 | |
| 1. 0.5% ninhydrin in acetone | 100°C, 10 min, saturated oven | 3 | + | + | + | + + |
| 2. 0.2% ninhydrin in acetone | 80°C, 10 min | 5 | + | + | + | + |
| 3. 0.4 g ninhydrin, 1.5 ml S-collidine in 100 ml 95% ethanol | room temperature | 6 | + | + | + | ± |
| 4. (A) 0.25 g ninhydrin, 50 ml ethanol, 10 ml acetic acid, 2 ml 2,4,6-collidine (B) 1% cupric nitrate · ($3H_2O$) in ethanol Mix A and B (25:1.5) just before use. | 100°C, 10 min | 7 | + | + | + | ± |
| 5. 0.075 g cadmium chloride, 6 ml water, 0.3 ml acetic acid, 100 ml acetone, 2 g ninhydrin | room temperature, 24 h, pink colors | 8 | + | + | + | + |
| 6. 0.3 g ninhydrin, 0.5 g cadmium acetate, 2 ml acetic acid to 100 ml with methanol | 110°C, 15 min, pink colors | 9 | + | + | + | + |
| 7. 0.1% ninhydrin in methanol | 100°C, 10 min | 9 | + | + | + | ± |
| 8. 0.2 g ninhydrin, 5 ml acetic acid, 95 ml *n*-butanol | 110°C, 5 min | 9 | + | + | − | ± |
| 9. 0.4 g ninhydrin, acetone to 100 ml | 10 min, 350 nm UV light | 10 | + | + | − | ± |
| 10. 0.3 g ninhydrin, 100 ml 2-propanol, 1 ml acetic acid | 90°C, 5 min | 10 | + | + | + | ± |
| 11. 1.0 g ninhydrin, 500 ml butanol, 0.5 ml collidine before use | 100°C, 5 min | 11 | + | + | ± | ± |
| 12. Gelman ninhydrin spray reagent 72818[a] | 105°C, 5 min | | + | + | + | − |
| 13. Search ninhydrin spray[b] | 105°C, 5 min | | + | + | + | + + |
| 14. Search ninhydrin spray in acetone[b] | 105°C, 5 min | | + | + | + | + + |
| 15. Faurot spray[c] | 105°C, 5 min | | + | + | + | + + |
| 16. Ninhydrin plus[d] | 100°C, 5 min. | | + | + | + | − |
| 17. Suggested method | 60°C, 30 min, saturated oven | 4 | + | + | + | + + + |

[a] Gelman Instrument Company, P.O. Box 1448, Ann Arbor, Mich.
[b] Sirchie Fingerprint Laboratories, Moorestown, N.J.
[c] Faurot, Inc., 299 Broadway, New York, N.Y.
[d] Applied Science Laboratories, Inc., P.O. Box 440, State College, Pa.

On larger articles (maps, etc.) the solution was sprayed lightly and then developed; any areas of weak visualization were resprayed and placed in the oven a second time.

**Results**

Although most methods visualized fingerprints to a greater or lesser degree, the reagent listed above most uniformly produced the darkest purple color and the finest detail. These results are not quantitative; however, they are obvious when all methods are viewed together. Glycine solutions of known concentrations were also spotted on the test sheets in amounts equivalent to 20, 7, and 1.5 μg per spot, previous to visualization; the results of this survey of the visualization of an amino acid are included in Table 1.

Figure 1 is a comparison of a single known fingerprint, cut in half vertically and

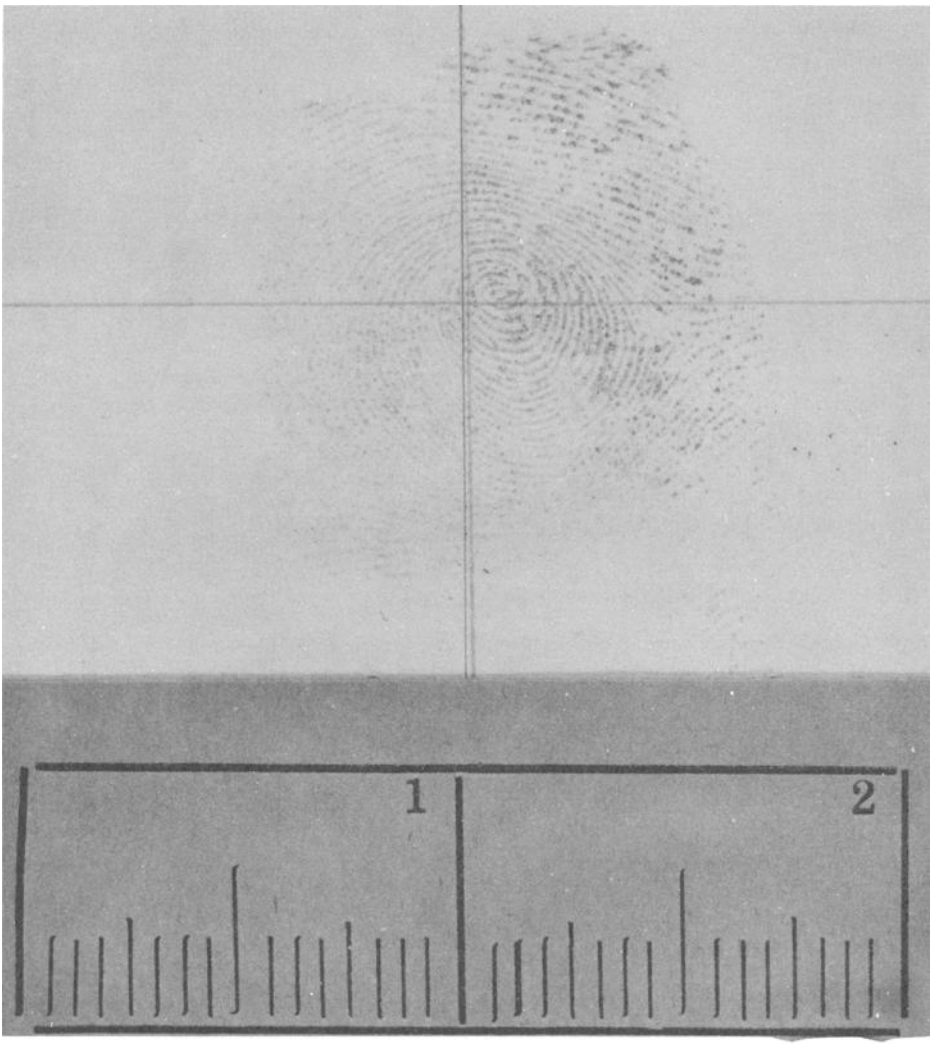


FIG. 1—*Comparison of two development methods using a single fingerprint:* (left) ***Method 1 in Table 1 and*** (right) *Method 17 in Table 1.*

visualized by the suggested method (right) and Method 1 (from Table 1), which is the method found to be the next most suitable (left).

## Discussion

After the ninhydrin treatment this technique can be complemented, if necessary, by impregnating the specimen with 5% silver nitrate solution and visualizing in sunlight or with an ultraviolet lamp. The suggested reagent, which is stable for at least one month in an amber bottle at room temperature, does cause some running of inks. This drawback is minimized by the high concentration of ninhydrin, but can be further reduced by repeated light spraying.

## Summary

A superior ninhydrin method is described for the visualization of latent fingerprints found on paper.

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## References

[1] Connor, C. M., *Journal of the Association of Official Analytical Chemists,* Vol. 55, No. 4, 1972, pp. 827—831.
[2] Söderman, H. and O'Connell, J. J., *Modern Criminal Investigation,* Funk and Wagnalls, New York, 1962, p. 134.
[3] Mooney, D. G., *Identification News,* Vol. 23, No. 9, 1973, pp. 9-11.
[4] Štefl, M., Tulach, J. and Sovova', A., *Collection of Czechoslovakian Chemical Communications,* Vol. 25, 1960, p. 435.
[5] Odén, S. and Hufsten, B., *Nature,* Vol. 173, No. 4401, March 1954, p. 449.
[6] Fieser, L. F., *Experiments in Organic Chemistry,* D. C. Heath, Boston, 1955, p. 136.
[7] Moffat, E. D. and Lytle, R. I., *Analytical Chemistry,* Vol. 31, No. 5, 1959, p. 926.
[8] Barrollier, J., *Naturwissenschaften,* Vol. 42, No. 14, 1955, p. 416.
[9] Stewart, C. P. and Stolman, A., *Toxicology Mechanisms and Analytical Methods,* Academic Press, New York, 1961, Vol. II, pp. 228, 573.
[10] Sunshine, I., *Manual of Analytical Toxicology,* The Chemical Rubber Co., Cleveland, 1971, pp. 378-379.
[11] Clark, J. M., *Experimental Biochemistry,* W. H. Freeman, San Francisco, 1964, p. 217.

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