

■ ORIGINAL ARTICLE

# Deciphering of secret written content written with various fluids

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## ABSTRACT

**CONTEXT:** When a hidden or covered message is needed to be conveyed to someone, the skill of secret writing is used as a means of conveyance. It is incorporated to create content undecipherable by the other person even by not hiding the existence of the secret conveyance of the content.

**AIMS:** The present study has been conducted with an approach of incorporating the secret handwriting on a blank paper using various household invisible inks and retrieved samples were assessed using various deciphering methods.

**MATERIALS & METHOD:** There are three different categories in which these invisible inks are classified. Invisible inks are fluids that are used for the same and do not come into sight unless it is revealed through any sort of process. These inks viz. revealed by heat, by any chemical reaction and those that are observed under UV light and iodine fuming method

**RESULTS:** It was observed through analyzing the samples that, heating technique was the best for the secret messages created using biological fluids, as writing became irreversibly visible after the development.

**CONCLUSIONS:** The results of the study concluded that different physical and chemical methods proves to be an approach for deciphering the various messages written with invisible inks.

**KEY MESSAGES:** Although the available methods for deciphering the secret written content are abundant nowadays but this task can also be done effectively with commonly available techniques.

**KEYWORDS** | Hidden message, invisible ink, UV light, iodine fuming

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## INTRODUCTION

**H**UMANS ARE INSTINCT FOR SECRETS AND revealing them to certain people. In history as well certain events can be found involving the art of secret in many aspects. Before the digital era, messages were often hidden with steganographic skills. Talking about technical steganography, writing with invisible ink is the most renowned skill.<sup>1</sup> The art of covered wiring or more technically, hidden writing is generally referred as secret writing.<sup>4</sup> Use of invisible inks is the earliest

method of secret writing, others may include the use of codes, marks, latent photographs etc. Other methods require advancements for development procedure.<sup>3</sup> In ancient times, use of certain liquids like lemon juice or milk has proved popular and effective for intentionally hiding the message.<sup>7</sup> Some traces for use of secret inks were seen during World-War II by secret agents;<sup>9</sup> writings were made with common household fluids like lemon juice, baking soda and urine.<sup>8</sup> In general, invisible ink

is a substance used in steganographic schemes so that secret messages can be invisibly written on papers.<sup>6</sup> Invisible inks do not come into sight unless it is revealed through any sort of process. These inks viz. revealed by heat, by any chemical reaction and those that are observed under UV light and iodine fuming method.<sup>1</sup> General household materials, organic fluids which comes under the category of household materials include fruit juices, biological fluids like blood in diluted form, sweat and even urine and the visualizing requirement may be met by means of heat. The principle behind the visualization is the disturbance of fibers caused due to application of the specific ink. These inks change the arrangement of fibers and that can be developed through heating the paper at mild temperature. The ink applied area turns brown faster than the surrounding causing the message to be seen with naked eyes. In addition to organic fluids, invisible inks can be of chemical origin. These inks, on contrary, require treatment with a specific reagent to be developed. Exposure to ultra-violet radiations may be used as one of the development methods but its reliability is comparatively low.<sup>2,6</sup>

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#### METHOD AND MATERIALS

To study the reliability of visualization methods for secret writing by various invisible inks, this study was done at Department of Forensic Science, Dyal Singh College, Karnal (Haryana). The inks used were fruits juices (apple juice, sugarcane juice, Bartlett Big juice), chemical fluids (Detergent, soapy water, Dettol) and vegetable juices (tomato, potato, onion) were utilized for preparing secret writing samples. A cotton bud was used as the writing instrument and A4 size blank papers were used for writing samples over them. To prepare the samples for writing, the cotton bud was dipped into particular ink and messages were written over blank sheet of paper. The papers were then marked with the name of ink used for sake of differentiation. The papers containing written messages were allowed to air dry under a running fan. They were then analyzed using

different visualizing methods. Those include physical (application of heat and ultra-violet radiations) and chemical (fuming with iodine crystals) method.

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#### DISCUSSION

The mentioned physical and chemical methods were utilized to find out the variations and sensitivity of visualization. The visibility of detergent and dettol by heat, gave positive results, while with UV, it showed a bit irregularity. On the other hand, the soapy water used as invisible ink did not show any kind of visibility by heat and under UV radiations as well. Visibility of all three chemical fluids with iodine fuming gave constant visibility (Fig: 3 & 4).

Varied results were observed for visibility of fruits juices when developed using physical methods. Apple juice, on contrast showed constant visibility (Fig. 1). The surface became brown after heating on hot plate at low temperature. Sugarcane and Bartlett big on contrary were not visualized under short UV light but gave positive results with heat and long UV. Visibility of these juices with chemical was constant.

The visibility of vegetable juices by physical methods gave regular and mostly constant results (Fig. 2) for all three inks that were used. Regular results in terms of visibility were observed when samples were treated with iodine fuming for all the three vegetable juices. The paper bearing the invisible writing became purple-brown in color after treating with Iodine fumes.

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#### CONCLUSION

From the results obtained in this study, it can be concluded that physical and chemical methods can be utilized to develop secretly written messages with different fruit juices, chemical and vegetable juice. The application of heat is the best method among other physical methods for decipherment of these kinds of inks. The advantage being quick and cheap procedure and it doesn't affect the document as well when

SR. NO.	TYPE OF FLUID	INK USED	CHEMICAL DEVELOPING METHOD RESULTS	PHYSICAL DEVELOPING METHOD RESULTS
1	Chemical	Detergent	Iodine Fuming	+++++ Heat UV Short -----
2	Chemical	Soapy water	Iodine Fuming	+++++ Heat UV Short ----- UV Long -----
3	Chemical	Dettol	Iodine Fuming	+++++ Heat UV Short ----- UV Long ++++

Table 1: Chemical fluids deciphered by physical and chemical methods

SR. NO.	TYPE OF FLUID	INK USED	CHEMICAL DEVELOPING METHOD RESULTS	PHYSICAL DEVELOPING METHOD RESULTS
1	Chemical	Detergent	Iodine Fuming	+++++ Heat UV Short -----
2	Chemical	Soapy water	Iodine Fuming	+++++ Heat UV Short ----- UV Long -----
3	Chemical	Dettol	Iodine Fuming	+++++ Heat UV Short ----- UV Long ++++

Table 2: Fruit juices visualized by physical and chemical methods

SR. NO.	TYPE OF FLUID	INK USED	CHEMICAL DEVELOPING METHOD RESULTS	PHYSICAL DEVELOPING METHOD RESULTS
1	Chemical	Detergent	Iodine Fuming	+++++ Heat UV Short -----
2	Chemical	Soapy water	Iodine Fuming	+++++ Heat UV Short ----- UV Long -----
3	Chemical	Dettol	Iodine Fuming	+++++ Heat UV Short ----- UV Long ++++

Table 3: Vegetable juices visualized by physical and chemical methods



Figure 1: Apple juice after treating at hot plate

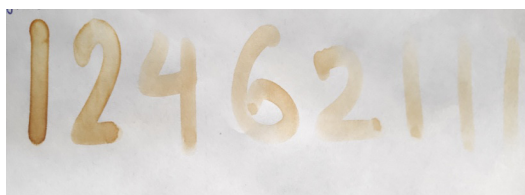


Figure 2: Onion juice after treating at hot plate

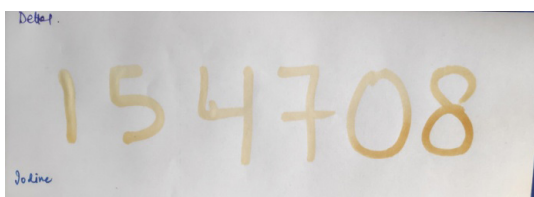


Figure 3: Dettol after treating with iodine fuming

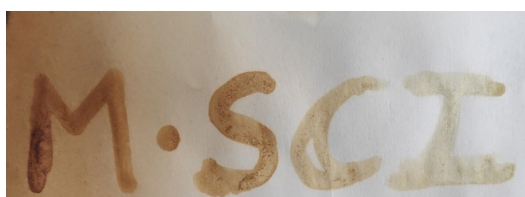


Figure 4: Detergent after treating with iodine fuming



Figure 5: Potato juice under long UV radiation

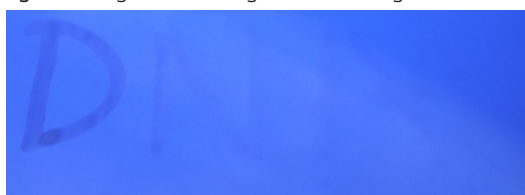


Figure 6: Onion juice under long UV radiation

care is taken while heating. The visualization under UV radiations being a non-destructive method does not give satisfying results in terms of visualization and proved to be time consuming technique. The chemical method viz. iodine fuming does not spoil the documents extensively and gives constant decipherment almost for all the invisible inks. The purple color fades away after sometime therefore it needs to be photographed immediately. However, it requires little more time than heating for development but gives satisfying results. Furthermore, to better understand the

visualization of different inks and factors that affect the development procedure over a period of time, studies can be conducted considering a large sample size and more kinds of invisible inks. **IJFMP**

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