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TO CONTRIVE ARTIFICIAL BLOOD FOR USE IN DEMONSTRATION OF BLOOD PATTERN ANALYSIS

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INTRODUCTION

Blood pattern analysis is the concept of blood behaviour which acts in a unique and different way when it is forced to emerge. It deals with the interpretation of bloodstains at the crime scene to recreate the caused bloodshed. It helps the investigator in drawing conclusions about the modus operandi, nature and the timing of crime, the direction of attack, the angle of attack, the probable distance between the victim and assailant, nature of force, nature of weapon, number of blows, the position of the suspect and the victim, description of the perpetrator such as height, which hand was used, the approximate time of crime committed, mens rea and actus reus, manner of crime like violent crime, act of defence, etc, and the sequence of events can be determined which eventually leads to the reconstruction of the crime. This happens because of the properties of blood. Blood has different properties such as viscosity, inertia, surface tension, as their physical characteristics and it also shows biological properties such as vascular spasm,

platelet plug, and clotting or agglutination. The composition of blood also plays a role in blood spatter. They altogether play a prominent role in deciding the spatter. And also, blood has a changing behaviour due to various factors and circumstances like velocity, pressure, force, weapon, surface, height, angles, etc. All these aspects are combined and studied in relation to each other and this study is called blood pattern analysis which is emerging as a vast subject in forensic science by playing a role in helping to solve a crime. Hence the examination of blood is vital in blood pattern analysis as well as academic research studies. For academic purposes, blood is hardly used because blood has its own problems such as both animal blood and human blood are expensive, have low marketability, i.e., rarely available to buy, blood decomposes; it is hazardous in nature causing blood poisoning and HIV (Human Immunodeficiency Virus), etc.

It has an offensive smell that could be intolerable to many and blood lysed with time and agglutinates which leads to false results in analysis. Hence academic and research studies cannot always rely on blood. And for this reason, many institutions, organisations, and scientists have formulated alternatives for blood. Theatrical blood was the most used blood, and this can be easily prepared by internet formulations. But they failed as they showed clots, pools, scales etc. And later, standard substitutes were formulated and got approved to only meet a few properties of blood. There is no current theatrical blood as such. However, NFBS, oxycyte, Awlata dye, and Millington substitutes are available and suitable for blood pattern analysis but the problem is, all of them are very expensive.

METHODOLOGY

So, the present study was conducted to develop a forensic blood substitute that is similar to human blood and of low cost. The objectives of this study are to develop an alternative of blood in a simpler way with few components which are cheap and also to validate their suitability for blood pattern analysis. The methodology of this study was designed in three steps. They are

- Preliminary development
- Evaluation
- Validation

1. Preliminary development:

In preliminary development, by referring to many articles, a mixture of multiple components such as starch, cellulose, waitrose, lyles, colouring dyes, albumin, etc, which were already present in existing alternatives, was developed in different ratios. Upon multiple attempts, the combination of albumin serum bovine, cellulose starch, and gram's safranin worked out well. Further, numerous substitutes with these three components in different ratios were developed. Six standard substitutes were formulated with different compositions. Each of them was tested at least 20 times to ascertain the nature of blood formed in a perpendicular drop and angled drop. The results with substitute no. 6 showed promise as the nature of drop in both perpendicular and angled drops were found to be similar to that of blood. This substitute 6 was regarded as the best suitable substitute for the study and the test was replicated.

2. Evaluation:

For evaluation, the chosen substitute was tested repeatedly

For evaluation, the chosen substitute was tested repeatedly several times against blood patterns for the correctness. The procedure was, each time, the blood and substitute comparison has been performed in 4 different patterns.

- The perpendicular falls at 2 different heights one at 40 cm and the other at 70 cm height.
- The angled fall from 2 different angles, i.e., 20 degrees and 60 degrees

The comparison was done in the span of three days.

On Day 1: 8 trials were performed with both blood and substitute

On Day 2: 40 repeats were done with 1 drop of blood against 40 drops of substitute.

And on the final day, 15 repeats were performed with 15 drops of substitute against 1 drop blood

Fig no.1.Day 1- Drop 1 from 40cm height

Fig no.2. Day 1- Drop 2 from 70cm height

Fig no.3.Day 1- Drop 3 from 40cm height

Fig no.4. Day 1- Drop 4 from 70cm height

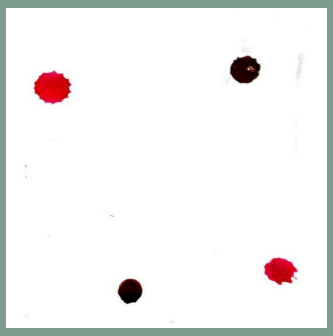

Fig no.5. Day 1- Drop 1 from from 20^{o} angle

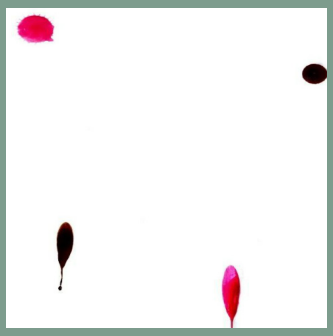

Fig no.6. Day 1- Drop 2 60^{o} angle

Fig no.7. Day 1- Drop 1 from from 20^{o} angle

Fig no.8. Day 1- Drop 2 60^{o} angle

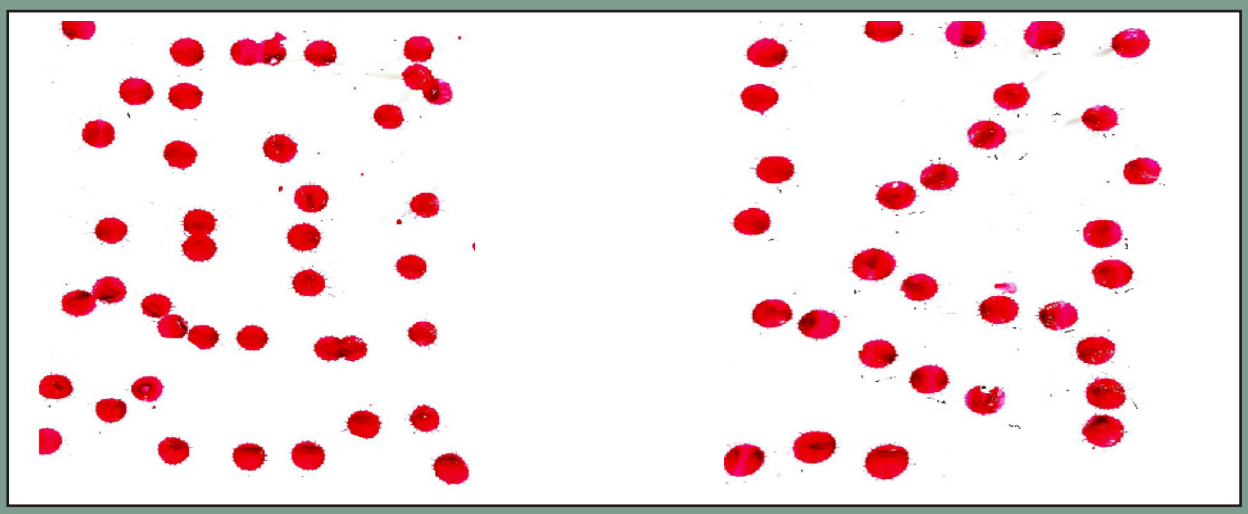

Fig no. 9. Day 2- 40 drops from 40cm height

Fig no. 10. Day 2- 40drops from 70cm height

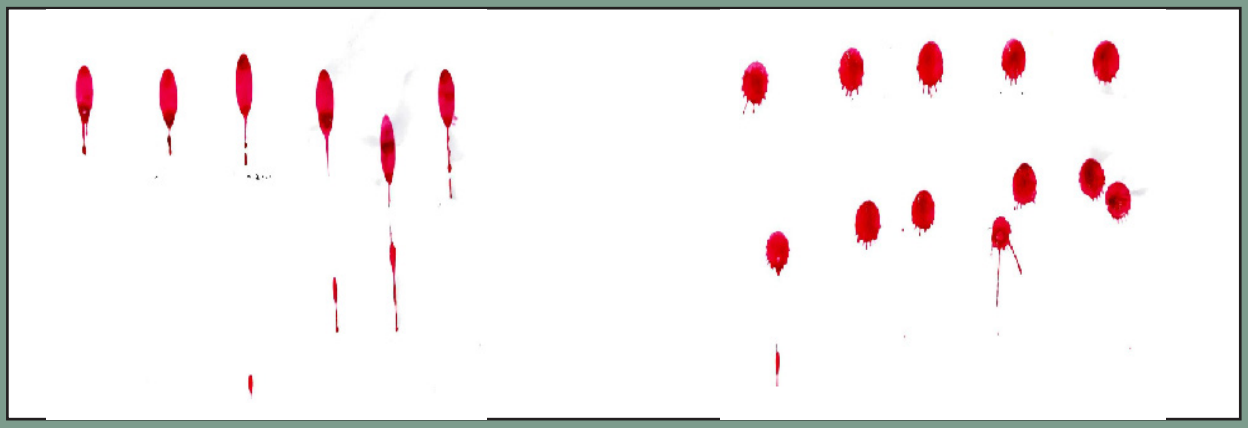

Fig no. 11. Day 2- 40 drops from 20^{o} angle

Fig no. 12. Day 2- 40drops from 60^{o} angle

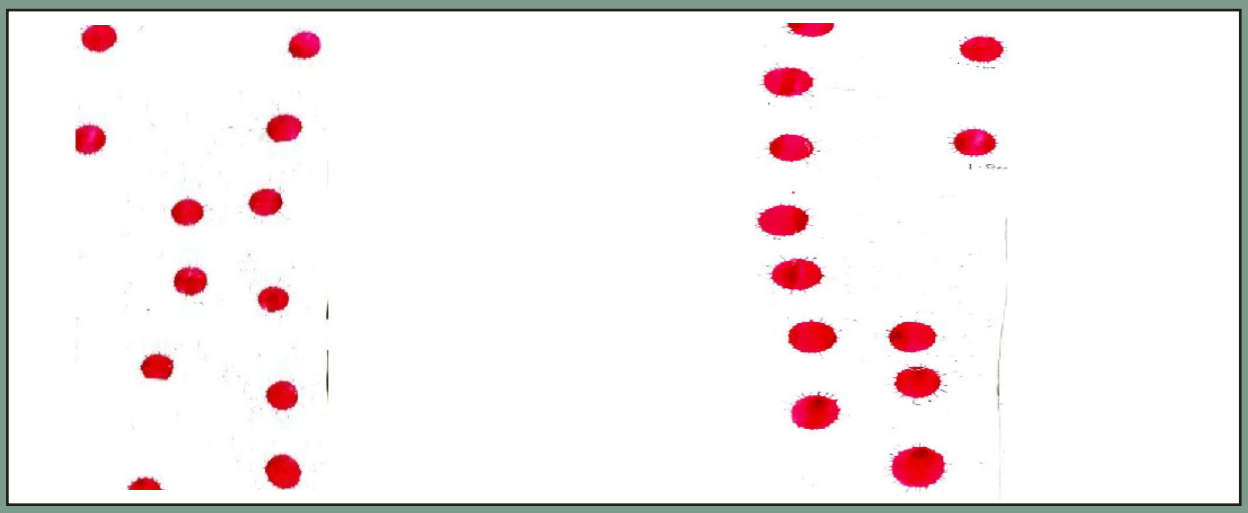

Fig no. 13. Day 3- 15 drops from 40cm height

Fig no. 14. Day 3- 15 drops from 70cm height

Fig no. 15. Day 3- 15 drops from 20degree angle

Fig no. 16. Day 3- 15 drops from 60degree angle

3. Validation:

Under validation, the length and width of each drop were measured and noted for all the trials and compared with blood drops. The mean diameter for perpendicular drops was calculated and the mean width by length ratio and mean estimated angles were calculated for angled drops. The average of different attempts, different heights and angles. And also, deviation between the values was also observed and calculated.

Day	Perpendicular Drop 40 cm		Perpendicular Drop 70 cm	
	Mean Diameter with Blood	Mean Diameter with Substitute	Mean Diameter with Blood	Mean Diameter with Substitute
1	1.25	1.25	1.42	1.49
2	1.43	1.41	1.55	1.55
3	1.41	1.44	1.58	1.58
Mean	1.36	1.37	1.52	1.54
Standard Deviation	0.10	0.10	0.09	0.04

Table 1. Validation of perpendicular drops

Validation of 20 degree drops

Day	20 degrees Perpendicular drop 70cm			
	Mean W/L ratio with blood	Mean W/L ratio with substitute	Mean estimated angle with blood	Mean estimated angle with substitute
1	0.45	0.45	26.83	26.71
2	0.41	0.45	24.22	26.45
3	0.41	0.34	24.32	20.09
Mean	0.42	0.41	25.13	24.42
Standard Deviation	0.02	0.06	1.48	3.75

Table 2. Validation of 20 degree angled drops

Validation of 60 degree drops

Day	60 degrees Perpendicular drop 70 cm			
	Mean W/L ratio with blood	Mean W/L ratio with substitute	Mean estimated angle with blood	Mean estimated angle with substitute
1	0.73	0.84	47.06	57.15
2	0.87	0.83	61.43	56.32
3	0.91	0.89	65.59	63.19
Mean	0.84	0.85	58.02	58.89
Standard Deviation	0.09	0.03	9.72	3.75

Table 3. Validation of 60degree angled drops

RESULTS AND ANALYSIS

The above results and tables reveal the average of values in each parameter chosen with respect to blood and the substitute. In perpendicular drops of 20 cm and 70 cm height, the study reveals that both with blood and substitute the diameter is more or less the same with a negligible standard deviation. In angled drops of 20 degree angle, the study reveals that the width/length ratio has more or less the same value for both blood and substitute, but the estimated angle has a wide variation. This can be due to the crude means used to arrive at an angle of 20 degree during the performance of the test. Similarly, in angled drops of 60 degree angle, the study reveals that the width/length ratio has more or less the same value for both blood and substitute, but the estimated angle has a wide variation. This can be due to the crude means used to arrive at an angle of 60 degree during the performance of the test.

CONCLUSION

In this study, the relation between the height of fall and the shape of the drop as well as the angle of fall and the size of the drop was demonstrated and established. The diameter of the drop increased with the increase in height and the tailing of the drop increased with the decrease in the length. Based on the results and validation of findings, it can be concluded that the fictitious blood developed here can be employed as a preliminary working alternative for additional research and academic studies especially for demonstration and understanding of blood pattern analysis with further development and standardization. It was manufactured in a few products which

were inexpensive and readily available and it could be prepared by anyone with no special equipment. It can also be stored and not harmful.

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FACTS !

Teeth are typically the most reliable identifiers when it comes to identifying a corpse. Teeth are bones, and bones last a long time so that's why teeth are typically used to identify bodies — they are correct around 93% of the time.