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Dermatoglyphic Study of Diabetic Patients and Non-Diabetic Population using Thin Layer Chromatography as an Analytical Tool

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Abstract

Background: Fingerprint analysis is one of the most robust biometric feature in terms of personal identification is concerned. But with the progression of science through research and development, fingerprint science is no longer considered as a potential biometric tool only. It has various other insights to it and our this study will reflect the same. Diabetes being of the most prevalent clinical condition among human population, has been considered as sample for the study. The latent dermatoghyphic analysis of diabetic individuals will depict significant results as compared to the normal individual and hence will be able to provide as a valuable disease marker.

Method: Thin Layer Chromatographic technique has been used for this study and it was conducted at the Presidency University, Kolkata. 12 diabetic individual samples along with non-diabetic, positive (In 3 different dilutions) and negative control samples were run. The samples were prepared in a specific technique and the results were also taken after a specific heat treatment of the TLC plates. Rf values were measured for all the samples.

Result: In case of positive control samples there were significant brownish-rust spots which were also consistent in diabetic individuals. On the other hand in case of negative control and non-diabetic individuals the spots were not visible on the plate.

Conclusion: Latent dermatoglyphic prints (finger-print) of diabetic population were taken for our major subject sample and compared with non-diabetic individual using Thin Layer Chromatography (TLC) to indicate the presence of glucose in the body. This study reveals the presence of the target molecule "glucose" in diabetic individuals which was not visible in case of non-diabetic individual. The detection of diabetes is possible through latent dermatoglyphic analysis even when the sweat residues are present in challenging amount and that too through a prick-free method. Hence, our study can provide a significant diagnostic tool for diabetic individuals.

Keywords: Dermatoglyphic pattern, Diabetes, Thin Layer Chromatography

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Introduction

Dermatoghyphic study is majorly the scientific study of epidermal ridges on certain parts of the body like fingers, palms and soles.[1] Our study mainly focuses with fingerprint analysis that too latent prints with the focus being the chemical composition keeping a specific target molecule, 'glucose'in mind. Breaking the limitations of only a robust biometric tool, fingerprint analysis has reached new heights and we too have incorporated in that study through our previous works. Here we aspire to indicate that Diabetic patients will show a prominent

result in the latent fingerprint sample when undergone Thin Layer Chromatographic analysis. Which can provide a simple and easy technique for the detection of glucose in the body and will set an alarm for precaution and prevention henceforth. Diabetes being one of the major health hazards in the history of medical science is one of the most encountered diseases of recent times too. The approach here is to help detect and differentiate out the diabetic individuals from normal non-diabetic individuals by an easy prick-free system.

Materials and Chemicals used: Glass fibre micro-filter paper, nitrile powder-less glove, tweezer, petridish, microcentrifuge tube, plastic zip-lock bag, LC-MS grade water, N-butanol, acetic acid, anisaldehyde, concentrated sulphuric acid, D(+) glucose anhydrous from Himedia, petroleum jelly (white) extra pure, TLC plate (Silica gel plate), TLC chamber, concentrator plus from Eppendorf, hot plate, spray bottle.

Sample Collection: Since the entire study focuses on diseased individuals versus normal individuals, the sample collection was done under two broad heads – Diabetic Patients and Non-diabetic individuals (where the blood glucose level was in the optimum range) with required clearance from ethical committee. Care was taken to collect the samples by handling the individuals only after wearing nitrile powder-free gloves. Subjects were told to thoroughly clean the hands before print collection to remove the external adhered materials. Latent prints were collected from the fingers of twelve diabetic patients and one non-diabetic individual on glass fibre micro-filter paper and the area was marked. The collected samples on filter paper were kept in an autoclaved Petri-dish and were covered with the lid to maintain a dirt-free environment and were air dried before further processing. The samples were then put inside zip-lock packets (which were passed through a decontamination process in a laminar air flow under UV light). Then the dried filter papers were prepared for further analysis.

Sample Preparation: The glass fibre micro-filter paper having latent finger-print samples of diabetic and non-diabetic individuals were soaked in 0.5ml (500 µl) of LC-MS grade water in micro-centrifuge tube for over-night. Then the next day the liquid part was taken with the help of a syringe (having 0.22µ syringe filter). The liquid was again concentrated to a volume of approximately 50µl in concentrator plus. For positive control, three different concentrations of glucose solution were prepared G1, G2 and G3 by adding 0.5gm of glucose powder with 0.5ml, 1ml and 1.5ml of LC-MS grade water respectively. Solvent Buffer for TLC chamber was prepared using N-butanol:acetic acid:water in the ratio of 40:10:50. Spraying reagent was prepared using 0.5ml of anisaldehyde in 50ml of acetic acid and 1ml of conc. sulphuric acid was added to it.

Method of Analysis

A clean TLC chamber was taken and 400ml of solvent buffer was added to it and the chamber was sealed with a lid by the help of petroleum jelly. In order to saturate the TLC chamber it was kept undisturbed for about 1hr. On the other hand three standard (different concentration) positive control, one negative control (Pure LC-MS grade water), twelve diabetic and one non-diabetic samples were taken in micro-centrifuge tubes and spotted on TLC-plates by micro-pipettes and tips. After spotting the samples were dried by hair-dryer for about 1hr. The plate was put in already saturated TLC chamber and run was given for 30 mins. After the run the plate was dried at 200°C for 30mins to 1hr on hot plate. The spraying reagent was sprayed on TLC plate and the plate was further dried for 10mins. Dried plate was then observed for results.

Result

Brownish-rust coloured spots were developed in positive control samples as well as diabetic samples and it was significantly absent in non-diabetic and negative samples.

In the above mentioned Fig. 1, one negative control and three positive controls with decreasing concentrations of glucose (from left to right) were run. In Fig. 2, one non- diabetic sample, one positive control and

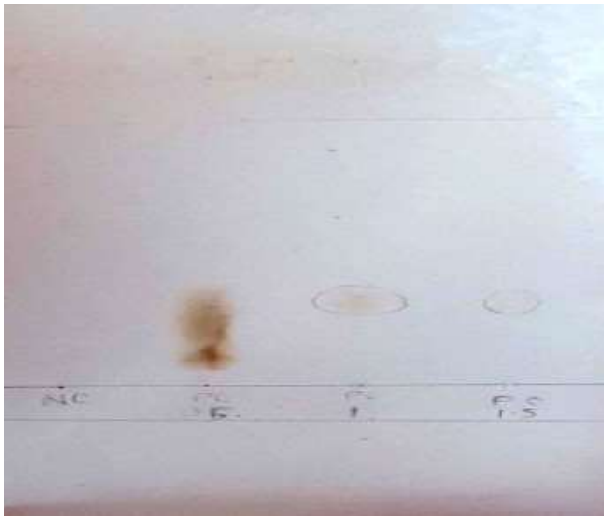

Fig. 1: TLC results of control samples (Negative and Positive)

twelve diabetic samples (from left to right) were run. The Retention factors (Rf) of all the above samples spotted on TLC plates are stated in the tabular form below.

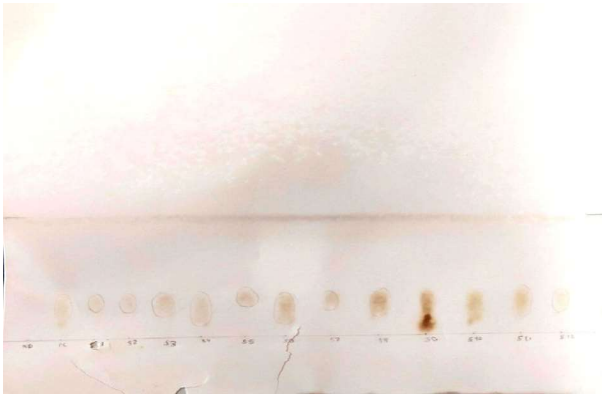

Fig. 2: TLC results of latent finger-print samples from Non-diabetic and diabetic individuals

Table 1: Rf values of the samples

Sr. No.	(Distanced Travelled in cm)		Retention Factor (Rf) A/B
	Spot (A)	Solvent (B)	
	Fig. 1		
NC (Negative Control)	-	5.5	-
G1 (Positive Control)	2.2	5.5	.4
G2 (Positive Control)	2.2	5.5	.4
G3 (Positive Control)	2.2	5.5	.4
	Fig. 2		
ND (Non-diabetic)	-	5.5	-
Positive Control	2.2	5.5	.4
S1 (Diabetic)	2.1	5.5	.381
S2 (Diabetic)	2.1	5.5	.381
S3 (Diabetic)	2.2	5.5	.4
S4 (Diabetic)	2.2	5.5	.4
S5 (Diabetic)	2.4	5.5	.436
S6 (Diabetic)	2.2	5.5	.4
S7 (Diabetic)	2.4	5.5	.436
S8 (Diabetic)	2.2	5.5	.4
S9 (Diabetic)	2.2	5.5	.4
S10 (Diabetic)	2.2	5.5	.4
S11 (Diabetic)	2.2	5.5	.4
S12 (Diabetic)	2.2	5.5	.4

Discussion

Humans have ~2-4 million eccrine sweat glands in total and are found on both glabrous (palms, soles) and non-glabrous (hairy) skin.[2-4] Gland density is not uniform across the body surface area. The highest gland densities are on the palms and soles (~250–550 glands/cm^2).[5] The dermatoglyphic study here basically deals with the latent finger-print analysis where the sweat residues from the finger-tips are studied for a specific target bio-molecule i.e., 'glucose' in our sample population. In order to maximize the probability of the result, the samples were concentrated to ten folds. Glucose when heated first starts to caramelize and then at a temperature above 177˚C (or 350˚F) it will burn leaving a black mass of carbon. In the latent dermatoglyphic print samples of diabetic patients, the similar brownish spots were visible as in case of the glucose solutions (used as positive control) correlating the presence of glucose in the latent finger-print samples that was significantly absent in the latent finger-print samples of non-diabetic and negative control samples. The Rf values of the standard control samples and that of the target samples (diabetic patients) were observed to be the same, that is 0.4.[7] except four out of twelve which gives values like 0.38 and 0.43 which again revolves around 0.4. Hence, it can be concluded that TLC can serve as a prospective qualitative tool for the detection of diabetes in individuals and that too by non-invasive, prick-free method.

Conclusion

The analytical findings reveal that not only blood but latent dermatoglyphic prints can also provide an indicator for diabetic patients which was in accordance with the blood glucose. The TLC analysis of twelve diabetic samples along with positive controls gave specific brownish spots which were not visible in negative control and non-diabetic individual. These brownish spots were believed to be present due to the release of glucose residues in the latent dermatoglyphic prints that was significant in diabetic patients. Hence, this study could provide a disease marker for diabetes by a non-invasive method besides narrowing down the search of diabetic patients from normal individuals.

Conflict of Interest: The authors declare no conflict of interest for this research study.

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