Analysis of the Effectiveness of DNA Quality Using the Short Tandem Repeat Combined DNA Index System (STR CODIS) –TH01 in Forensic Identification

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Abstract: Evidence identification methods are developing towards molecular DNA (Deoxyribonucleic acid) forensics for personal identification, tracing genetic relationships and tracking the source of biological material. The identification process using DNA has many variations, one of which is through Short Tandem Repeat (STR) analysis. This study aims to analyze DNA touch quality on face shields by giving using STR CODIS TH01. The sample consisted of 2 respondents determined by random sampling. Respondent I was used to measure DNA quality on day 1 and respondent II was used to measure DNA quality on day 7. The quality of DNA on face shields was different on day 1 and day 7. On day 1, the average DNA content was 1.29, while on day 7 the average DNA content was 1.22 with an average daily environmental temperature of 28.75ºC and average daily humidity of 89.5%.The conclusion is DNA quality experienced changes in different exposure times as indicated by the average DNA levels on day 1 and day 7. Differences in DNA quality still provide good visualization results on gel electrophoresis so that it can still be used as identification material, especially forensic identification.

1. INTRODUCTION

Forensics is defined as the process of proving a crime case through the application of multidisciplinary scientific knowledge (Moore 2013). There are many types of forensic identification methods, and currently the development of their application has used analysis through molecular biology (da Silva and de Oliveira 2008). Molecular biology analysis includes examining DNA from human body specimens (Yudianto and Erfan Kusuma 2006). DNA analysis in criminal investigations can be used as medicolegal legal evidence in court (Nte et al. 2019). Samples found in crime cases are generally samples that are no longer in good condition or have been degraded by the environment(Tozzo et al. 2022). Forensic sample collection and examination must be carried out appropriately so that the sample can provide accurate results. Examination with Short Tandem Repeat (STR) can be used as a method for forensic samples because the DNA sequence reading area is relatively low, namely in short sections of DNA (less than 1 kilo basepair) which are polymorphic and can be analyzed with a very small number of samples (Yudianto et al. 2020). Source Forensic samples can not only be found in human body specimens but can also be obtained from property. Property is items that are around the crime scene and are suspected of being used as tools to assist in committing the crime(Puspa et al. 2022). Property can be used as evidence if there is a transfer of DNA from the perpetrator or victim via DNA Touch (Sessa et al. 2019). DNA touch is a mechanism for transferring biological material from the body to an object (Puspa et al. 2022). Forensic identification via DNA is quite accurate, but environmental and post-mortem factors can cause DNA damage (Sessa et al. 2019). Therefore, it is necessary to conduct research on the effectiveness of the quality of DNA samples that can still be used to provide valid results so that they can be used as valid evidence in court.

2. METHOD

The sample consisted of 2 respondents determined by random sampling. Respondent I was used to measure DNA quality on day 1 and respondent II was used to measure DNA quality on day 7. The DNA touch sample collection was obtained by asking the respondent to use a new face shield that had on ben opened from the wrapper and then the face shield was used for 3 hours while doing outdoor activities. The face shield for each respondent was divided into 7 parts and

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DNA quality testing on Human Genetic Institute of Tropical Disease Laboratory, Airlangga University. Primer locus yang digunakan adalah STR – CODIS TH01: (-CTGGGCACGTGAGGGCAGCGTCT-/TGCCGGAAGTCCATCCTCACAGTC-).

3. RESULT

Results of measuring DNA touch levels in face shield samples on day 1 and day 7 using a spectrophotometer.

Tabel 1. The Results of DNA Touch Level Measurement

Exposure time	Number of sampel	Average level DNA (X ± SD) (µg/ml)	Average DNAPurity
Day 1	7	1778 ± 529.3	1.29
Day 7	7	856 ± 258.5	1.22

DNA levels and purity (table 1) in samples on day 1 and day 7 decreased. The DNA levels of samples on day 1 and day 7 had exceeded the minimum DNA level to be able to proceed to the electrophoresis stage, namely 0.25 ng.

Tabel 2. Normality test

Variabel	Kolmogorov Smirnov		
Kadar DNA	Statistic	Df	Sig.
Hari ke-1	.228	7	.200
Hari ke-7	.276	7	.116

The results of the normality test (table 2) obtained a value of sig > α (0.05) which states that the data is normally distributed.

Tabel 3. One Way Anova test

	Df	F	Sig
Between group	1	17.148	001
Within Group	12		
Total	13		

The statistical test results (table 3) state that the sig value is < α (0.05), which means that there is an influence of the length of exposure on the quality of DNA for forensic identification.

The electrophoresis results (figure 1) show visualization of positive results (+) in samples with the highest and lowest levels. A positive (+) result for the TH01 locus is proven by the presence of a band in the range 152 – 195 bp (basepair) in each DNA touch sample on day 1 and day 7.

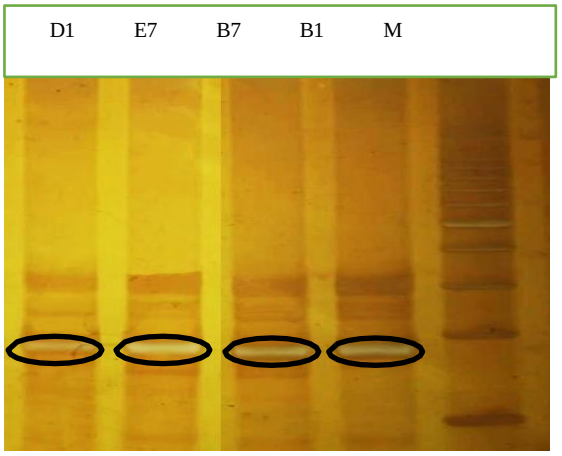

Fig. 1. Elektroforesis Result

Note :

D1 (Sample day 1) : Highest Rate
E7 (Sampel day 7) : Highest Rate
B7 (Sample day 1) : Lowest Rate
B1 (Sample day 7) : Lowest Rate
M (Marker ladder) : 100 bp

4. DISCUSSION

The quality of DNA, which includes the purity and content of the DNA used as analytical material, can influence the success of DNA analysis (Sophian and Syukur 2021). DNA quality has a tendency to decrease over time of exposure (Kirkinen et al. 2022). The factor that influences the decline in DNA quality is the ability of the body surface as a medium for transferring DNA to other objects (shedder status) (Burrill et al. 2021). Touch DNA originating from corneocytes originates from the surface of the epidermis which is considered to still contain skin epithelial DNA for use as a forensic DNA examination (Tobias et al. 2017). Skin corneocytes contain little DNA and are easily fragmented, so the identification method used is STR (short tandem repeat) so that the results produced can still be meaningful for forensic identification (Burrill et al. 2021) (Yudianto and Sispitasari 2017). Other factors such as the environment can also influence the reduction in DNA quality. Sample storage conditions are related to humidity, where low humidity has a relatively low success rate due to the influence of increased temperature due to UV rays which can cause damage to DNA (Huang et al. 2017). The porous surface of the face shield can also be a factor causing a decrease in DNA quality due to the partial migration process into the substrate, thus affecting the optimal success of DNA extraction (Tasker et al. 2020).

Even though there was a decrease in DNA quality in the face shield sample, visualization using electrophoresis still gave a (+) result, this was indicated by the appearance of bands in the sample that had the highest to lowest levels.

5. CONCLUSION

Long exposure time to forensic samples affects the decline in DNA quality, however this reduction can still be used as an identification result because it is still within the range of minimum levels and purity of DNA samples and the visualization process using electrophoresis can still produce DNA bands.

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