Cukurova Medical Journal

Araştırma Makalesi / Research Article

Forensic Profiling of Javanese and Madurese Families in Malang and Madura, East Java Indonesia.

Malang ve Madura, Dogu Java Endonezyasındaki Javalı ve Madurese'li Ailelerde Adli Profilleme

Nikmatul Iza[1], Eriko Prawestiningtyas[2], Fatchiyah Fatchiyah[1]

[1]Departement of Biology, Faculty of Mathematics and Natural Sciences, Brawijaya University Malang, East Java, INDONESIA.

[2]Laboratory of Forensic Medicine, Faculty of Medicine, Brawijaya University Malang, INDONESIA.

Cukurova Medical Journal 2014;39(1):26-38.

ABSTRACT

Purpose: The aims of this study are to identify the heritability of fingerprint patterns among three generations of Javanese and Madurese families and to determine the similarities, genetic variability and allele patterns for paternity testing.

Material and Methods: The methods used in this study were the identification of the fingerprint patterns, DNA extraction from blood samples by salting out, PCR amplification use 13 CODIS which consists of TPOX, D3S1358, FGA, D5S818, CSF1PO, D7S820, D8S1179, TH01, VWA, D13S317, D16S539, D18S51, D21S11, and visualized by 8% polyacrylamide gel. The allele of individual band profile was analyzed by using QuantityOne software.

Results: The results of fingerprint patterns showed that the families of Javanese ethnic has specific in ulnar patterns on both the middle and little fingers, meanwhile the families of Madurese ethnic has a plain whorl patterns on the right thumb and left index fingers which were inherited from the first generation to the next generation. The similarities of profile DNA forensic in Javanese ethnic generally have the same band patterns were produced by using D7S820 and CSF1PO markers, whereas in Madurese ethnic by using VWA and D18S51 markers. The genetic variability in Javanese ethnic by using D3S1358 and D21S11 markers, meanwhile the Madurese ethnic by using TH01 and D21S11 markers.

Conclusion: We can conclude that there are the different characteristic of the fingerprint pattern of Javanese and Madurese families and the similarities and genetic variability in families of Javanese were different with the families of Madurese on the some markers.

Key words: DNA Forensic, Fingerprint, 13 CODIS, Javanese and Madurese ethnic.

ÖZET

Amaç: Bu çalışmanın amaçları Javalı ve Madureseli ailelerin üç jenerasyonu arasında genetik olarak aktarılabilen parmak izi paternlerini tanımlamak ve benzerlikleri, genetik çeşitliliği ve babalık testi için alel paternlerini saptamaktır.

Materyal ve Metod: Bu çalışmada kullanılan yöntemler DNA parmak izi paternelerinin tanımlanması, tuzla çöktürme ile kan örneklerinden DNA ekstraksiyonu, TPOX, D3S1358, FGA, D5S818, CSF1PO, D7S820, D8S1179, TH01, VWA, D13S317, D16S539, D18S51, D21S11'i içeren 13 CODIS kullanılarak PCR amplifikasyonu ve %8'lik poliakrilamid jel ile görüntüleme. Bireysel bant profilleri QuantityOne software ile analiz edilmiştir.

Bulgular: Parmak izi pattern sonuçları göstermiştir ki Javalı etnik gruptaki aileler hem orta hem de küçük parmaklarındaki ulnar paternler bakımından özgün iken, Madurese etnik grubundaki ailelerin sağ baş parmaklarında

ve sol işaret parmaklarında bir jenarasyondan diğerine aktarılan helezonlu (whorl) şekle sahiptir. Javalı etnik gruptaki adli DNA profillenmesindeki benzerlikler, D7S820 ve CSF1PO markerları kullanılarak üretilen paternler genellikle aynı iken, Madureseli etnik gruptakilerde VWA ve D18S51 markerları kullanılarak üretilen paternler aynıdır. Javalı etnik gruptaki genetik çeşitlilik D3S1358 and D21S11 markerları kullanılarak, Madureseli etnik gruptaki ise TH01 ve D21S11 markerları kullanılarak saptanmıştır.

Sonuç: Javalı ve Madureseli ailelerde farklı parmak izi özellikleri vardır ve Javalı ailelerdeki benzerlik ve genetik çeşitlilik bazı markerlar bakımından Madureseli ailelerden farklıdır.

Anahtar Kelimeler: Adli DNA, Parmak izi, 13 CODIS, Java ve Madurese Etnik Grupları

INTRODUCTION

There are three kind of specific examination to identify each person according to forensic identification which consist of fingerprint examination, dental examination, and DNA examination[1]. It is absolutely different from one another. Fingerprint is unique to each person and each finger, as well as a twin[2,3,4]. Its pattern never changed, except getting serious accident[2]. Fingerprints classified into three basic types are the loop, arch, and whorl. Two types of the loop patterns are ulnar loop and radial loop. Two types of the arch patterns are plain arch and tented arch, and four types of the whorl pattern are plain whorl, central pocket loop, double loop, and accidental[3,5]. Fingerprints are the most widely used biometric feature for identification person and verification in the field of biometrics[5] and used in forensic divisions worldwide for criminal investigations[3], as well as DNA has become the gold standard of forensic testing and is an invaluable tool for the criminal[6]. Both of them used as the most accurate in forensic identification, what is more that the DNA can also as a gold standard for paternity testing[7,8]. Genetic identity testing is achieved by examining polymorphic regions of DNA. Currently, short tandem repeat (STRs) markers are the most commonly used loci for human identification[9,10,11]. Although the human genome contains thousands upon thousands of STR markers, only a small core set of loci have been selected for use in forensic DNA and human identity testing[12]. STRs occur as a result of repeating DNA sequences which is normally 2 to 6 bp in length[11,12]. Since 1990, the FBI in the USA recommended the forensic laboratory to used the 13 Combined DNA Index System (CODIS) STR are CSF1PO, FGA, TH01, TPOX, VWA, D3S1358, D5S818, D7S820, D8S1179, D13S317, D16S539, D18S51, and D21S11[7,11,13].

Indonesia is a large country in south East Asia which consists of hundreds of island and diversities of ethnics. This research aims to study the characteristic of fingerprint and DNA forensic of 13 CODIS in Javanese and Madurese ethnics in Indonesia as a preliminary study for human race diversity and moreover to study the basic of the family genealogy among Javanese and Madurese ethnic.

MATERIALS AND METHODS

Subject

Fingerprint and blood samples were collected from three families consist three generations of Javanese ethnic[1], grandfather-mother father-daughter-son:[2] grandfather-grandmother-mother father-daughter[3], grandfather-grandmother-mother father-son, living in easten Java island, Indonesia and two families consist three generations of Madurese ethnic:[1] grandfather-father mother-daughter[2], grandmother-mother father-son, living in Madurese island, Indonesia.

Ethical consideration

The study was approved by ethical review committee of medical research, Faculty of Medicine, Brawijaya University, Indonesia and consent forms were obtained from all participants.

Procedure

The identification of the fingerprint patterns were printed on identification paper. DNA extraction from blood samples were achieved by salting out method. Quantity and quality of DNA was measured by using UV spectrophotometer and electrophoresis on 0.8% agarose gel[14].

PCR amplification used 13 CODIS consist of TPOX, D3S1358, FGA, D5S818, CSF1PO, D7S820, D8S1179, TH01, VWA, D13S317, D16S539, D18S51, D21S11, and amelogenin for sex identification. PCR amplification performed in a thermal cycler with the reaction mixture that was exposed to 1 min of initial denaturation at 94ºC, 35 cycles of denaturation at 94ºC for 1 min, annealing at 60ºC for 1 min, extension at 72ºC for 1 min, and final extension at 72ºC for 10 min. PCR products were visualized by electrophoresis on 8% polyacrylamide gel stained with ethidium bromide and were carried out at constant current of 50 Volt until the tracking dye reaches 0.5 cm above the base of the gel. The gels were documented by using ChemiDoc Gel Imaging (Bio Rad).

Data Analysis

The analysis of the fingerprint to determine the fingerprint patterns of each family and the analysis of the DNA forensic of individual band profile with measuring the allele used QuantityOne software to determine the similarities and genetic variability among individual using 13 CODIS.

RESULT

Identification of Fingerprint patterns

The identification of fingerprint patterns from the Javanese ethnic families showed that ulnar loop pattern dominated in both on right and left hand fingers. Ulnar loop patterns dominance in 1st family that was derived from the 1st generation to the next generation on the right thumb, both the middle and the little fingers. The second dominant pattern that was found was plain whorl pattern. The 3rd generation had a variation plain whorl pattern on the left little finger, which were not inherited from the previous generation. Ulnar loop patterns dominance in the 2nd family on the both middle and little finger, as well as the left ring fingers. The 2nd generation had a variation plain whorl pattern on the left middle finger, left ring finger and the left little finger which were not inherited from the 1st generation. Ulnar loop patterns dominance in the 3rd family on the both middle and little fingers, as well as the left ring finger. At this family was also found a few patterns, they are plain arch pattern, plain whorl pattern and the pattern of double loops. The 2nd generation had a variation plain arch pattern on the both middle finger and right ring finger. The 3rd generation has a variation plain whorl pattern on the right thumb (Table 1).

The identification of fingerprint patterns on the Madurese ethnic families showed that plain whorl and ulnar loop pattern dominated both on right and hand fingers. Plain whorl pattern of dominance could be seen in the right thumb and left index finger. Ulnar loop dominance patterns in the 1st family on both the middle and little fingers, whereas the 2nd family on the right middle finger. In the 1st family, the plain whorl patterns variation found in the 3rd generation which not inherited from the previous generation, meanwhile on the 2nd family, there are variations of accidental pattern of right thumb on the 2nd generation (Table 2). The dominance of the fingerprint patterns in Javanese families as shown in Figure 1A and Madurese families in Figure 1B.

Table 1. Fingerprint patterns in Javanese Families

1st Family											
No	**Name**	**Right**					**Left**				
		T	**I**	**M**	**R**	**L**	**T**	**I**	**M**	**R**	**L**
	1st generation										
1.	Grandfather	U	U	U	U	U	U	U	U	U	U
	2nd generation										
1.	Mother	U	U	U	U	U	U	CP	U	U	U
2.	Father (Law)	PW	PW	PW	PW	PW	U	PW	PW	PW	U
	3rd generation										
1.	Daughter	U	U	U	PW	U	U	U	U	PW	U
2.	Son	PW	PW	U	PW	U	U	U	U	PW	PW
2nd Family											
No	**Name**	**Right**					**Left**				
		T	**I**	**M**	**R**	**L**	**T**	**I**	**M**	**R**	**L**
	1st generation										
1.	Grandfather	PW	PW	U	PW	U	DL	PW	U	U	U
2.	Grandmother	U	PW	U	U	U	U	U	U	U	U
	2nd generation										
1.	Mother	PW	PW	U	PW	U	DL	PW	PW	PW	PW
2.	Father (Law)	U	U	U	U	U	U	U	U	U	U
	3rd generation										
1.	Daughter	U	U	U	U	U	U	U	U	U	U
3rd Family											
No	**Name**	**Right**					**Left**				
		T	**I**	**M**	**R**	**L**	**T**	**I**	**M**	**R**	**L**
	1st generation										
1.	Grandfather	U	PA	U	U	U	U	PA	U	U	U
2.	Grandmother	U	PW	U	U	U	DL	PW	U	U	U
	2nd generation										
1.	Mother	U	PA	PA	PA	U	U	PA	PA	U	U
2.	Father (Law)	DL	U	U	PW	U	DL	U	U	DL	DL
	3rd generation										
1.	Son	PW	PA	U	U	U	U	PA	U	U	U

Note: T= Thumb, I= Index, M= Middle, R= Ring, L= Little, U= Ulnar Loop, R= Radial loop, PW= Plain Whorl, CP=CentralPocket Loop, DL= double loop.

Table 2. Fingerprint patterns in Madurese Families

1st Family											
No	**Name**	**Right**					**Left**				
		T	**I**	**M**	**R**	**L**	**T**	**I**	**M**	**R**	**L**
	1st generation										
1.	Grandfather	PW	PW	U	DL	U	PW	PW	U	DL	U
	2nd generation										
1.	Father	PW	U	U	U	U	U	U	U	U	U
2.	Mother (Law)	U	U	U	U	U	U	PW	U	U	U
	3rd generation										
1.	Son	PW	PW	U	PW	U	PW	PW	U	DL	U
2nd Family											
No	**Name**	**Right**					**Left**				
		T	**I**	**M**	**R**	**L**	**T**	**I**	**M**	**R**	**L**
	1st generation										
1.	Grandmother	PW	PW	U	PW	U	DL	PW	U	PW	U
	2nd generation										
1.	Father	PW	PW	U	U	U	AC	PW	PW	PW	U
2.	Mother (Law)	PW	PW	PW	PW	PW	PW	PW	PW	PW	PW
	3rd generation										
1.	Son	PW	U	U	PW	PW	PW	PW	U	U	PW

Note: T= Thumb, I= Index, M= Middle, R= Ring, L= Little, U= Ulnar Loop, R= Radial loop, PW= Plain Whorl, CP= Central Pocket Loop, DL= double loop.

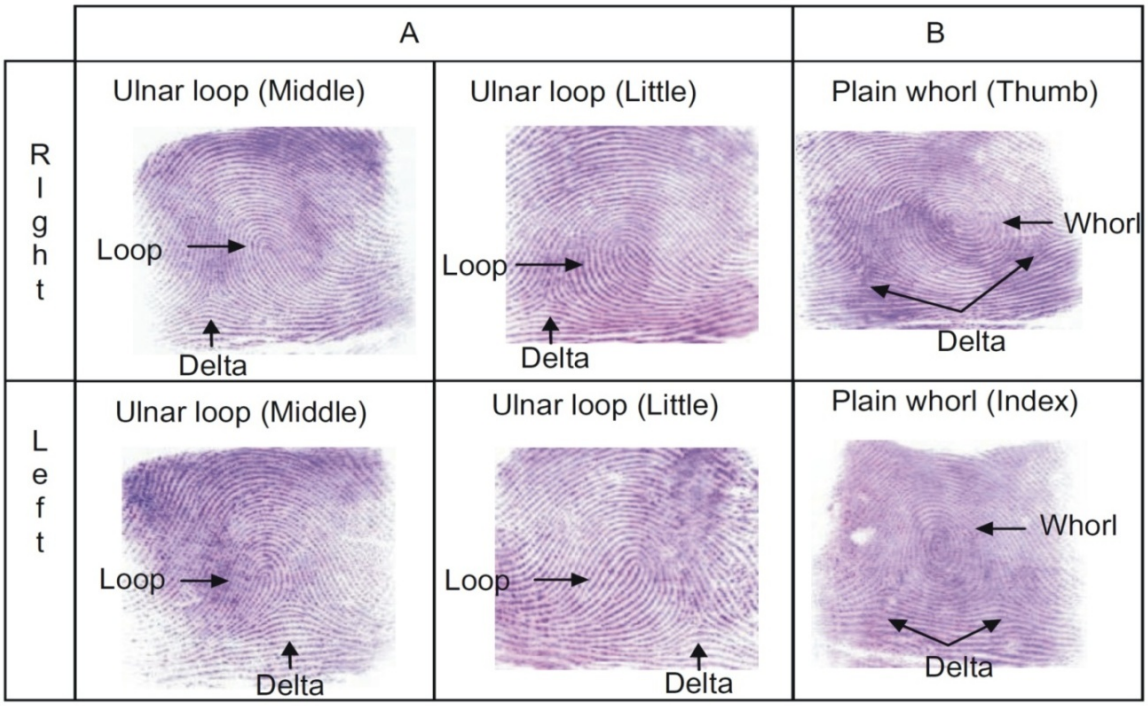

Figure 1 (Iza *et al.*, 2013)

Figure 1. Fingerprint pattern that was dominant. A. in Javanese family that has ulnar patterns on both the middle finger and little finger. B. in Madurese family has plain whorl pattern on the right thumb and left index finger.

Similarities and Variability of Profile DNA Forensic

The similarities of profile DNA forensic in Javanese ethnic on the 1st family showed the same band patterns were produced by using D5S818, D7S820, and VWA markers. In the 2nd family the similarities were generated using CSF1PO and D18S51 markers and the 3rd family by using CSF1PO and D7S820 markers, inherited from the 1st generation to next generation. The Genetic variability of the 1st and 2nd family were produced by using D3S1358 and D21S11 markers and the 3rd family by using D3S1358 marker, were not derived from the 1st generation to the next generation. The DNA Forensic profile of Javanese families indicated the similarities used CSF1PO marker shown in Figure 2B & C and genetic variability used D3S1358 marker shown in Figure 2D, E & F. The amelogenin band pattern shown in Figure 2A, which were the male subjects formed the two bands with two alleles, meanwhile the women subject formed one bands with one allele.

The similarities of profile DNA forensic in Madurese ethnic on the 1st family showed the same band patterns generated by using D3S1358, D7S820, VWA, and D18S51 markers and the 2nd family by using FGA, D5S818, VWA, and D18S51 markers, derived from the 1st generation to the next generation, whereas the genetic variability of the 1st and 2nd family by using TH01 and D21S11 markers. The DNA Forensic profile of Madurese families, showed the similarities and variability used D18S51 and TH01 marker shown in Figure 3A-D

Figure 2 (Iza *et al.*, 2013)

Figure 2. Visualized gel electrophoresis by 8% polyacrylamide on Javanese families (A-B-C = similarities used CSF1PO, allele 6/8); D-E-F = variability used D3S1358, D. allele 17/19, 19/19, 16/19, 17/19, 17/19. E. allele 15/19, 16/19, 15/18, 18/19, 17/19. F. allele 19/19, 16/19, 17/19, 17/19, 17/19); G1 = 1st generation (grandfather-grandmother), G2 =2nd generation (father), G2* =2nd generation (mother/law), G3 = 3rd generation (son-daughter), K+ = positive control, K- = negative control, M = marker 100 bp DNA ladder).

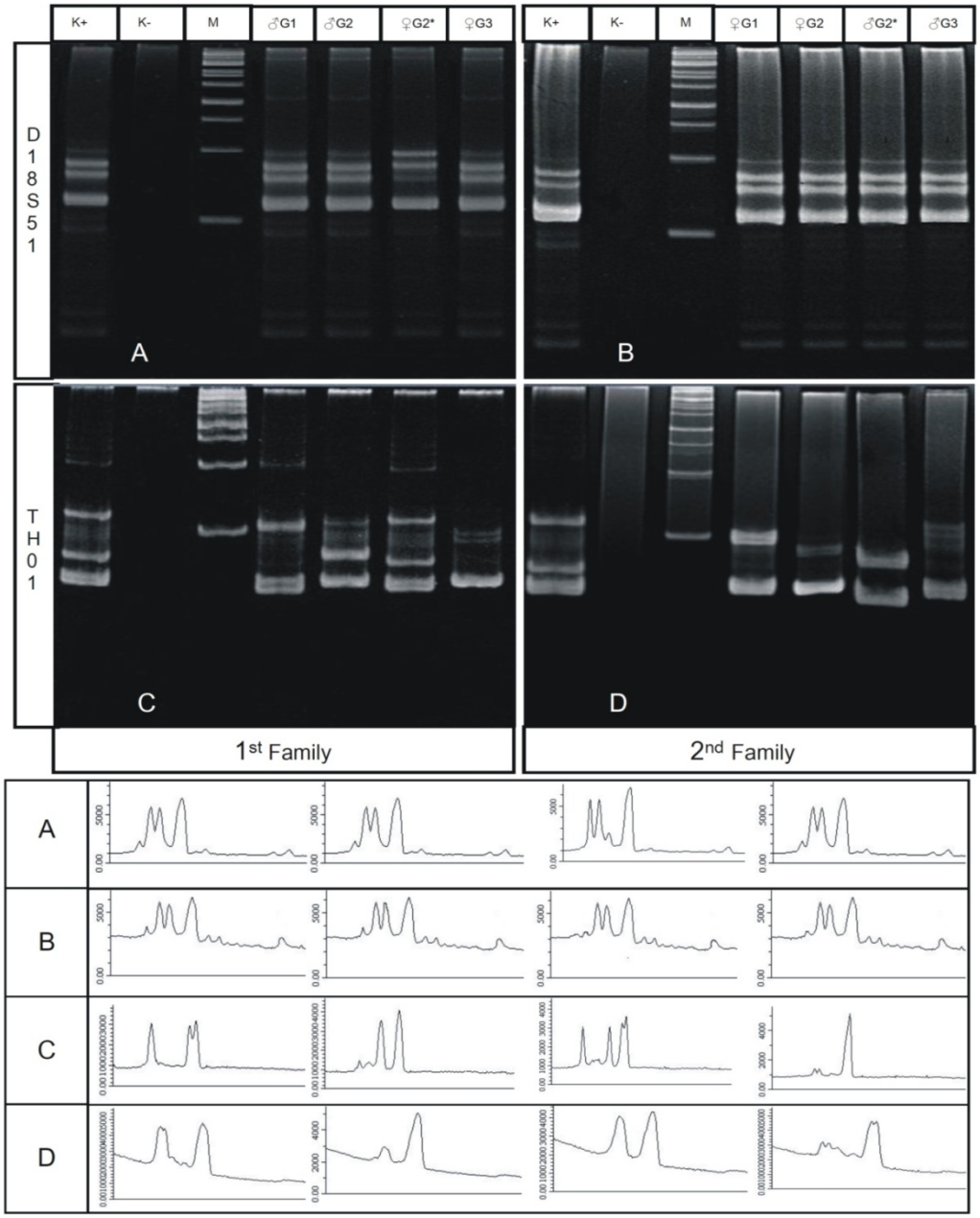

Figure 3 (Iza *et al*., 2013)

Figure 3. Visualized gel electrophoresis by 8% polyacrylamide on Madurese families (A-B = similarity used D18S51, allele 7/9) ; C-D = variability used TH01, C. allele 7/8, 8/9, 7/10, 10/10, D. allele 7/10, 10/10, 8/11, 11/11); G1 = 1st generation (grandfather-grandmother), G2 =2nd generation (father-mother), G2* =2nd generation (father-mother/law), G3 = 3rd generation (son-daughter), K + = positive control, K-= negative control, M = marker 100 bp DNA ladder).

Percentage of similarities and genetic variability of each families were identified by using the 13 CODIS showed that the Javanese ethnic marriage in the 1st family, similarities inherited from 1st to 2nd generation which is 30.77% and genetic variability of 69.23%. The 2nd to 3rd generation respectively derived similarities there were 61.54% and 53.85% which are higher than of genetic variability there were 38.46% and 46.15%, whereas the genetic variability in 1st to 3rd generation has higher percentage than of similarity there were 61.54: 38.46% and 76.92% : 23.08% (Figure 4A). In the 2nd family, The variability were inherited each generation showed the overall percentage which are higher than the percentage of similarities there were 53.85% : 46.15%, 61.54% : 38.46%, 69.23% : 30.77% and 76.92% : 23.98% (Figure 4B). Percentage of the 3rd family showed the genetic variability had higher than the variability those are 69.23% : 30.77%, 76. 92% : 23.08%, and 61.54% : 38.46%, except for the 1st to 3rd generation of 46.15% : 53.85% (Figure 4C).

Percentage of similarities and genetic variability in the Madurese ethnic marriage in the 1st family showed the similarities derived from 1st to 2nd generation which is 46.15% and genetic variability of 53.85%. The 2nd to 3rd generation successive inherited similarities there were 53.85% and 23.08% and genetic variability there were 46.15% and 76.92%, meanwhile the similarities in the 1st to 3rd generation had higher percentage than of genetic variability of 53.85%: 46.15% (Figure 4D). In the 2nd family, The genetic variability were inherited each generation showed the overall percentage which are higher than the percentage of similarities there were 61.54% : 38.46%, 76.92% : 23.98%, and 53.85% : 46.15%, except for the 2nd to 3rd generation of 38.46% : 61.54% (Figure 4E). The overall the profile of DNA forensic in families of Javanese and Madurese showed that the percentage of variability was higher than the percentage of similarities within each family.

Allele Identification for Paternity Testing

The allele of DNA forensic based on 13 CODIS in families of Javanese ethnic in the 1st family from the 2nd to 3rd generation (mother-father-daughter/son), in the 2nd family from the 1st to 2nd generation (grandfather-grandmother-mother), in the 3rd family from the 1st to 2nd generation (grandfather-grandmother-mother) and the 2nd to 3rd generation (mother-father-son) were 12 marker inclusion (the alleles match with both parents), consist of TPOX, D3S1358, FGA, CSF1PO, D5S818, D7S820, D8S1179, TH01, VWA, D13S317, D16S539, and D18S51 and 1 marker exclusion is D21S11, whereas the 2nd family from the 2nd to 3rd generation (mother-father-daughter) were all of the marker showed the inclusion.

The allele of DNA forensic based on 13 CODIS in families of Madurese ethnic in the 1st family from the 2nd to 3rd generation (Father-mother-daughter) and in the 2nd family from the 2nd to 3rd generation (father-mother-son) were 12 marker inclusion, consist of TPOX, D3S1358, FGA, CSF1PO, D5S818, D7S820, D8S1179, VWA, D13S317, D16S539, D18S51, and D21S11 and 1 marker exclusion is TH01. The inclusion of allele showed the dominance in the paternity test within each family.

DISCUSSION

Ulnar loop pattern were found dominant in Javanese families on both the middle and little finger. This loop pattern was consists of one or more curving ridges and one delta, where the ridges flow in from the little finger side[3,5]. The dominant pattern of fingerprints on the Madurese ethnic families have plain whorl pattern on the right thumb and left index finger. Plain whorl pattern is one type of whorl pattern that consists of one or more free shaped ridge that curved spiral, oval, or circular with two point delta, where the plain whorl pattern formed a one or more ridges around the center with two delta[3,5]. The dominant of loop pattern in Javanese and whorl pattern in Madurese

occurrence might have been due to the genetic admixture that happened in the current population through marriage. This result was supported by several previous studies in the Dumagat-Remontado tribal population of the Philippines to genetic admixture led to the dominant occurrence of the ulnar loop pattern in the fingerprints[15] and in the admixed population of Chinese the increase of whorl frequency[16]. This pattern can be influenced by many genes are involved[15]. The study of fingerprints pattern have been accurate tool for personal identification and determination of paternity for quite some time. It proved important, because the dermal ridges and the configurations formed are not affected by age, meanwhile the detailed structure of individual ridges are extremely variable and throughout postnatal life they are not affected by environment[17]. The features of a fingerprint depend on the nerve growth on the skins surface. This growth is determined by genetic factors and environmental factors such as nutrients, oxygen levels and blood flow[3].

The similarities of profile DNA forensic in families of Javanese ethnic generally have the same band patterns that were identified and produced by using D7S820 and CSF1PO markers, whereas in family of Madurese using VWA and D18S51 markers. D7S820 and VWA is a specific marker in the population in Indonesia, beside D5S818, D13S317, and TH01[13]. All of the Asian population has the same pattern on CSF1PO, and D18S51 is the same as Vietnam[13]. Genetic variability in families of Javanese generally by using D3S1358 and D21S11 markers, meanwhile the Madurese ethnic by using TH01 and D21S11 marker. D21S11 is a polymorphic STR marker[11]. The genetic variability can be caused the gene flow/migration, crossing over, and recombination[18]. Gene flow is the micro evolutionary process of gene exchange between populations or gene pools. Crossing over is the process breakage and exchange between two nonsister chromatids of the four homologous chromatics present at prophase I of meiosis and furthermore the recombination is the process of breakage and subsequent rejoining of segments of DNA through crossing-over that result in new variation or recombinants[18]. Beside of it, we used DNA forensic on 13 CODIS for paternity testing. Determination of the alleles using the 13 CODIS can be used for a paternity test based on the range of alleles[12]. Each locus in individuals can have two alleles homozygous or heterozygous, where one allele inherited from his mother and the other allele from the father or have the same allele from both parents[19]. A DNA paternity test is most accurate from of testing possible to determine parentage. If the patterns do not match on two or more marker, it could be exclusion as a biological father and the probability of paternity is 99.9% or greater [8].

We conclude that there are the different characteristic of the fingerprint pattern of Javanese and Madurese families and the similarities and genetic variability in families of Javanese were different with the families of Madurese on the some markers.

ACKNOWLEDGEMENT

The authors thanks to Directorate of General Higher Education, Ministry of Education and Culture of Indonesia for the “BUDN” scholarship, to Didik Hartono and Dwi Listyorini for manuscript correction, to Farahdita Dewi Masyitoh for her help to collecting samples, to Rr. Fitria Dewi Listiani and Reva Yuliasari for their help in the laboratory.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

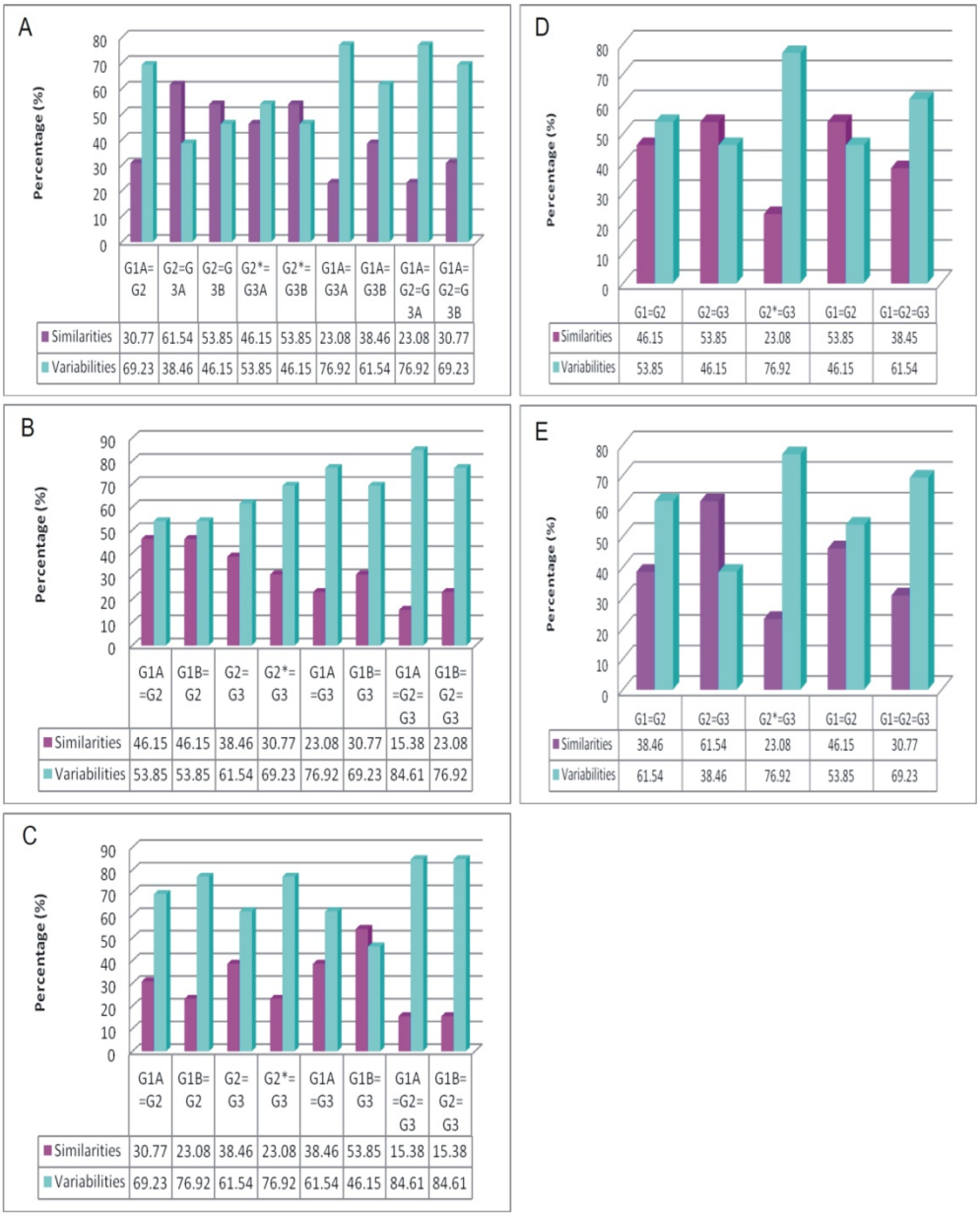

Figure 4 (Iza *et al.*, 2013)

Figure 4. Percentage of genetic similarity and variability by used 13 CODIS. A. Javanese of first family, B. Javanese of second family, C. Javanese of third family, D. Madurese of first family, E. Madurese of second family. G1A = 1st generation (grandfather), G1B = 1st generation (grandmother) G2 =2nd generation (father-mother), G2* =2nd generation (father-mother/law), G3 = 3rd generation (son-daughter).

REFERENCES

1. Prawestiningtyas E and Algozi AM. Identifikasi forensik berdasarkan pemeriksaan primer dan sekunder sebagai penentu identitas korban pada dua kasus B. Jurnal Kedokteran Brawijaya. 2009;25:87–94.
2. Muslim. Fingerprint pattern recognition using distance methode algorithm. Proceedings of the 2nd IMT-GT Regional Conference on Mathematics, Statistics and Applications. University Sains Malaysia. 2006;13-5.
3. Awasthi V, Awasthi V and Tiwari KK. Fingerprint analysis using termination And bifurcation minutiae.International Journal of Emerging Technology and Advanced Engineering. 2012;2:124–30.
4. Omar MY, Ellsworth,L. Possibility of using fingerprint powders for development of old fingerprints. Sains Malaysiana. 2012;41:499–504.
5. Bhargava N, Bhargava R, Narooka P and Cotia M. Fingerprint recognition using minutia matching. International Journal of Computer Trends and Technology. 2012;3:641–3.
6. Frumkin D, Wasserstrom A, Davidson A. and Grafit A. Authentication of forensic dna samples. Forensic Science International. 2009;489:95–103.
7. Yamamoto T, Mizutani M, Uchihi R, Tanaka M, Yoshimoto T, Misawa S, Saitou N, and Katsumata Y. Allele distributions and genetic relationship with 13 CODIS core STR loci in various Asian populations in or near Japan. International Congress Series. 2003;1239:117–20.
8. Steele B and Reynolds M. DNA fingerprinting. An interactive qualifying project report. Degree of Bachelor of Science. 2004:1-83.
9. Chung DT, Drábek J, Opel KL, Butler JM, and McCord BR. A study on the effects of degradation and template concentration on the amplification efficiency of the STR Miniplex primer sets. Journal of forensic sciences. 2004;49:733–40.
10. Butler JM, Shen Y and McCord BR. The development of reduced size STR amplicons as tools for analysis of degraded DNA. Journal of forensic sciences. 2003;48:1054–64.
11. Butler JM. Forensic DNA typing. Biology, technology and genetics of STR markers 2nd edition. USA. 2005:85-121.
12. Butler JM. Short tandem repeat typing technologies used in human identity testing. BioTechniques. 2007:43(4).
13. Untoro E, Atmadja DS, Pu C and Wu, F. Allele frequency of CODIS 13 in Indonesian population. Legal medicine 2009;11:203–5.
14. Fatchiyah, Arumingtyas EA, Widyarti S, Rahayu S. Biologi molekular. Prinsip dasar analisis. Penerbit Erlangga. Jakarta.; 2011:22–57.
15. Gutierez SB, Lucenario JL, and Yebes MJ. Dermatoglyphic studies among the Dumagat-Remontado tribal population of the Philippines. Journal of Anthropology. 2012:1-6.
16. Cheng X, Li H, Gupta S, Pan S, Hou J, and Jin L. Dermatoglyphic changes during the population admixture between Kam and Han Chinese. Journal of Comparative Human Biology. 2009;60:143–57.
17. Gupta UK and Prakash S. Dermatoglyphics: a study of finger tip patterns in bronchial asthma and its genetic disposition. Kathmandu University Medical Journal. 2003;1:267–71.
18. Meier RJ. The nature of human biological and genetic variability. Phisical (Biological) Anthropology. USA; 2010.
19. Gunasereka RS, Haschake J and Costas JD. The Judical use of DNA evidence and forensic expert testimony in the criminal justice system. Journal of Forensic Research. 2010;1:2-5.

Yazışma Adresi / Address for Correspondence:
Dr. Fatchiyah Fatchiyah
Department of Biology,
Faculty of Mathematics and Natural Sciences,
Brawijaya University
Malang, East Java, INDONESIA.
e-mail: fatchiya@ub.ac.id, and fatchiya@gmail.com

geliş tarihi/received :27.09.2012
kabul tarihi/accepted:23.10.2013