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Observation of Tri-allelic Patterns in Autosomal STRs during Establishment of Genetic Fingerprint Database for the Iraqi Security Forces

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Abstract

We report five cases of tri-allelic patterns observed during establishment of genetic fingerprint database for 354 individual from Iraqi security forces volunteers. These individuals had been typed by using the PowerPlex® Fusion System for the following 22 autosomal STRs: D3S1358, D1S1656, D2S441, D10S1248, D13S317, Penta E, D16S539, D18S51, D2S1338, CSF1PO, Penta D, TH01, vWA, D21S11, D7S820, D5S818, TPOX, D8S1179, D12S391, D19S433, FGA and D22S1045. All five tri-allelic patterns were observed at the Penta D locus and had the genotype 9/11/13, 9.4/13/14, 9/10/11, 7/9/11 and 9/10/14 respectively. All cases belonged to the Type 2 tri-allelic pattern; involve a fairly balanced set of three alleles. Five cases in 354 typed individuals is a frequency for tri-allelic patterns in autosomal STRs of 1.41%.

Keywords: Tri-allelic patterns; DNA typing; Autosomal; Short tandem repeat (STR); PowerPlex® Fusion System; Iraqi security forces; Iraq.

Introduction

Genotyping of polymorphic short tandem repeat (STR) loci is widely used in forensic DNA analysis and kinship testing. Together with off-ladder alleles and primer binding site mismatches yielding silent (null) alleles, tri-allelic patterns are a third category of genotyping irregularities which can be encountered during STR profiling.[1,2] Current study reported five cases of tri-allelic patterns observed during establishment of genetic fingerprint database for the Iraqi security forces.

Material and methods

Iraqi Security Forces (ISF) samples (354) were collected. Whole blood samples, buccal swabs and hair follicles were the sample types of choice. Blood is one of the richest sources of DNA. All samples were collected from donors volunteering in the

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AL-Muthana Military hospital by dedicated medical personnel. Three milliliters of blood were collected through venipuncture into 3 ml sterile EDTA blood collection tubes which were labeled with the subject's name, rank, age, sex and the date. Afterwards, the blood stains were made from the collected blood on a FTA™ Classic Card (Whatman™).

FTA cards were packed into individual clean paper envelopes for easy transfer to their final destination in the forensic genetic laboratories in DNA Typing Department of Medico-legal Directorate / Ministry of Health / Baghdad / Iraq. All samples were made anonymous, given serial numbers after collection and analyzed according to standard operating procedures. All possible measures were taken to prevent contamination. DNA profiles consisting of the following 22 autosomal STRs were determined:, D3S1358, D1S1656, D2S441, D10S1248, D13S317, Penta E, D16S539, D18S51, D2S1338, CSF1PO, Penta D, TH01, vWA, D21S11, D7S820, D5S818, TPOX, D8S1179, D12S391, D19S433, FGA and D22S1045, using the PowerPlex® Fusion System (Applied Biosystems). PCR products were separated by capillary electrophoresis on the ABI 3130xl Genetic Analyzer (Applied Biosystems) and alleles were identified using ABI's Genemapper software.

Results

In the present study, five tri-allelic patterns were observed at the Penta D locus of samples 35, 65, 93, 100 and 145 (Table 1). The Penta D tri-alleles are 9/11/13, 9.4/13/14, 9/10/11, 7/9/11 and 9/10/14 respectively as shown in Figures (1, 2, 3, 4 and 5), making these samples an example of a ''Type II'' tri-allelic pattern, according to the nomenclature of Clayton et al.[3] These samples genotyped twice on the genetic analyzer 3130xl to verify the results and the same tri-allelic pattern were obtained.

Table 1: The total tri-allelic patterns observed in present study and reported on STRBase.

STRBase		In present study	
STR Locus	**Variant alleles**	**STR Locus**	**Variant alleles**
CSF1PO	9/11/12; 10/11/12	–	–
FGA	19/20/21; 19/22/23; 19/24/25; 20/21/22; 20/21/24; 20/23/24; 21/22/23; 21/25/26; 22/24/25; 22.2/23/23.2	–	–
TH01	7/8/9	–	–
TPOX	6/8/10; 6/9/10; 6/10/11; 6/10/12; 7/9/10; 7/10/11; 8/9/10; 8/10/11; 8/10/12; 8/11/12; 9/10/11; 9/10/12; 10/11/12	–	–
VWA	11/16/17; 12/18/19; 14/15/17; 14/15/18; 14/16/18; 14/17/18; 15/16/17; 18/19/20	–	–
D3S1358	15/16/17; 15/17/18; 16/17/19; 17/18/19	–	–
D5S818	10/11/12; 11/12/13	–	–
D7S820	8/9/12; 8/10/11	–	–
D8S1179	10/12/13; 10/12/15; 12/13/14; 12/13/15; 13/15/16	–	–
D13S317	8/11/12; 10/11/12; 10/12/13	–	–
D16S539	12/13/14	–	–
D18S51	12/13/15; 12/14/15; 12/16/17; 14/15/22; 15/16/20; 16/17/20; 19/22.2/23.2	–	–
D21S11	28/29/30; 28/30.2/31.2; 29/31/32; 30/30.2/31	–	–

Contd... Table 1: The total tri-allelic patterns observed in present study and reported on STRBase.			
Penta D	None reported yet in STRBase	**Penta D**	**9/11/13; 9.4/13/14; 9/10/11; 7/9/11; 9/10/14**
Penta E	None reported yet in STRBase	–	–
D2S1338	None reported yet in STRBase	–	–
D19S433	None reported yet in STRBase	–	–
SE33	None reported yet in STRBase	–	–
D6S1043	None reported yet in STRBase	–	–
D1S1656	None reported yet in STRBase	–	–

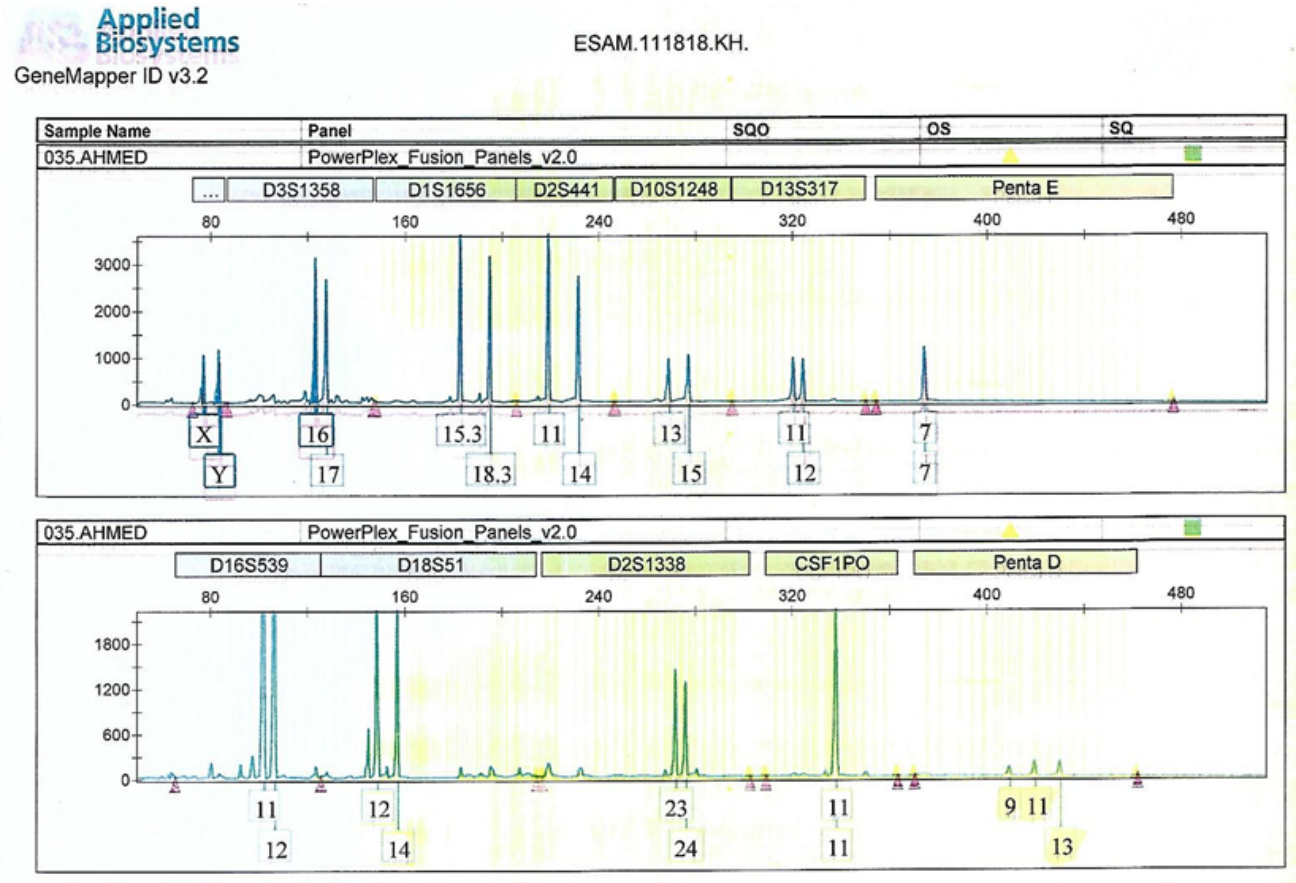

Figure 1: Tri-allelic pattern 9/11/13 observed in Penta D genetic locus from sample number 35.

Figure 2: Tri-allelic pattern 9.4/13/14 observed in Penta D genetic locus from sample number 65.

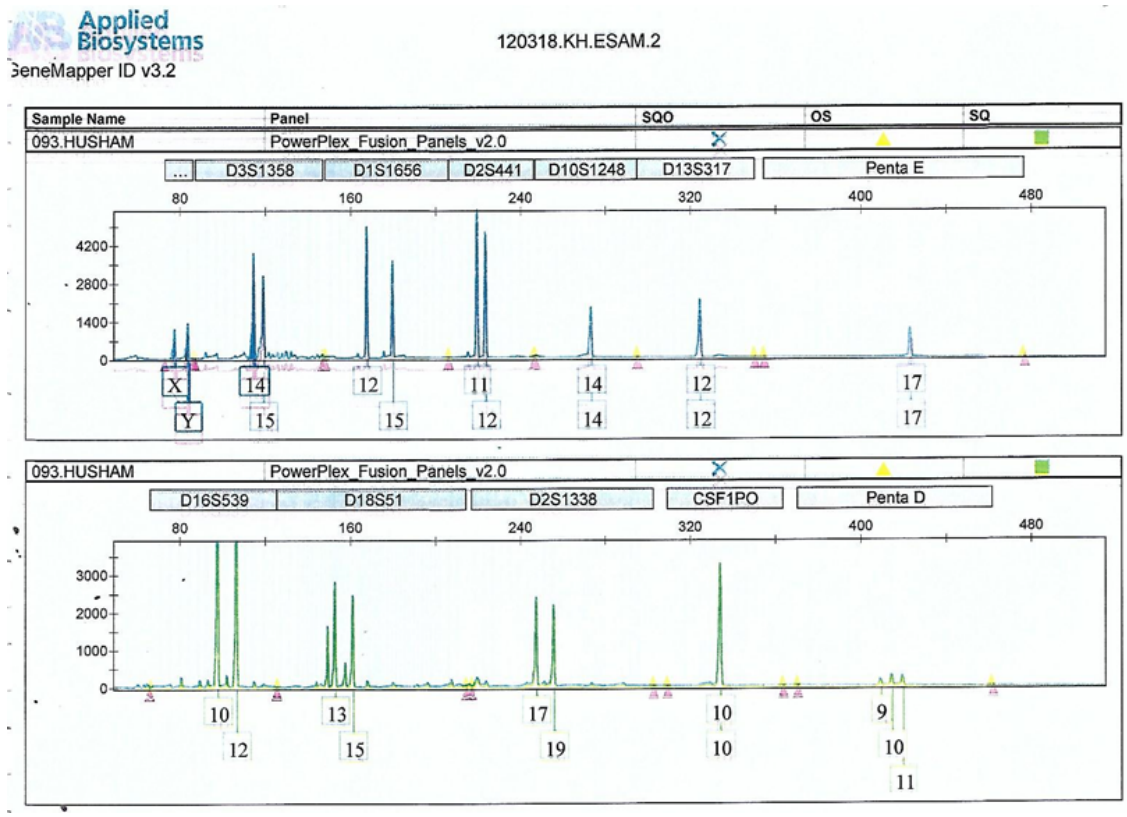

Figure 3: Tri-allelic pattern 9/10/11 observed in Penta D genetic locus from sample number 93.

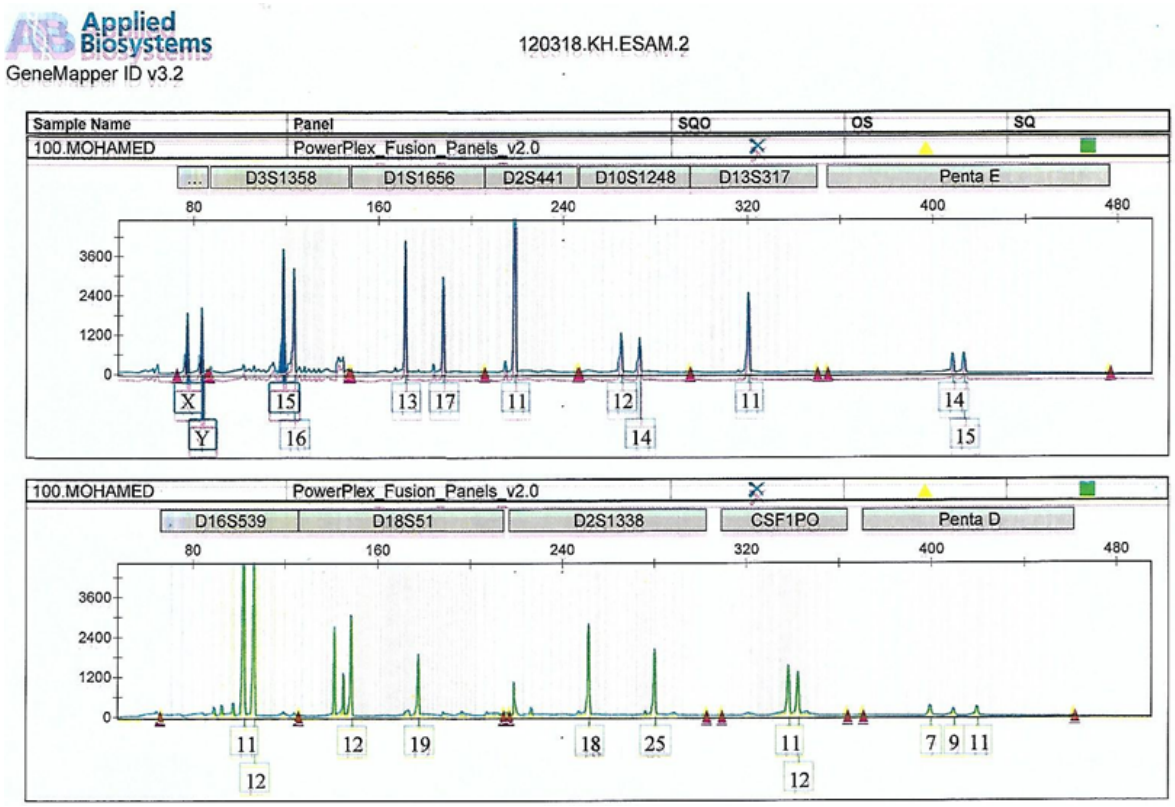

Figure 4: Tri-allelic pattern 7/9/11 observed in Penta D genetic locus from sample number 100.

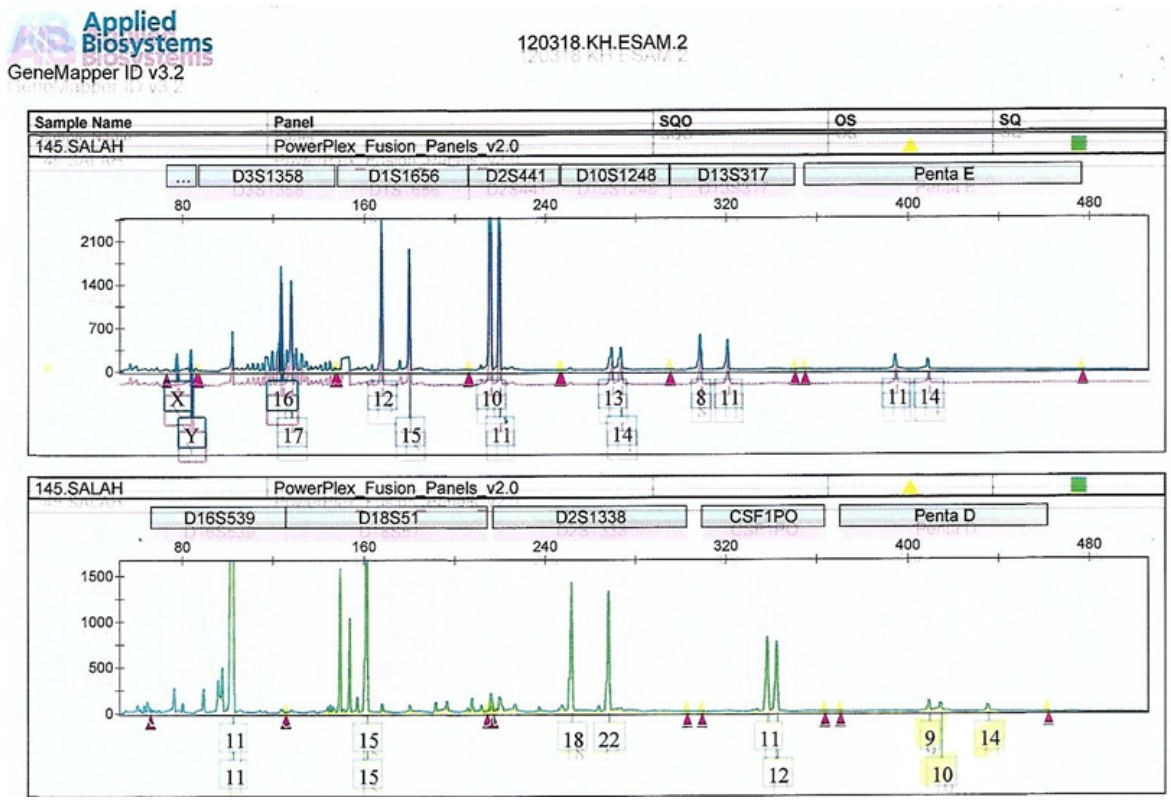

Figure 5: Tri-allelic pattern 9/10/14 observed in Penta D genetic locus from sample number 145.

Discussion and conclusion

The five cases of tri-allelic patterns we observed were all examples of the type 2 pattern. In a series of 15 tri-allelic patterns published by Huel et al.[4], there were 12 Type I and 3 type II (three peaks of even height) patterns. Thus, the type I pattern occurs significantly more frequently than the type II pattern. A type I pattern is explained by somatic mutation of one allele during an individual's development, resulting in a chimera with some cells containing the original allele and others the mutant allele. A type II pattern is caused by a localized intrachromosomal duplication event or chromosomal aneuploidy. In case of an intrachromosomal duplication event, it is likely that the two resulting alleles would be tightly linked and therefore inherited in progeny. A case of tri-allelic inheritance at locus D3S1358 was reported by Vidal and Cassar.[5] 179 patterns of tri-allelic variants of autosomal STRs have been reported on the STR Internet Database of NIST.[6] Five cases in 354 typed individuals in our study, is a frequency for tri-allelic patterns in autosomal STRs of 1.41%. Two other published series reported frequencies of 0.05%[4] and 0.18%.[7]

Conflict of Interest: None

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Ethical Clearance: Not required

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