Group-Specific Component(Gc) Polymophism in Korean

I. An Investigation on the Phenotypic Distribution of Jeju-do Population

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韓國人에서의 Group-Specific Component(Gc)의 Polymorphism에 관한 研究

I. 濟州島人集團에서의 Gc 表現型의 分布에 대하여

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Summary

The polymorphism of the Group-Specific Component(Gc)was studied in serum samples from Jeju-do population of Korea using thin layered(1mm) polyacrylamide gel isoelectric focusing (PAGIF). Six common subtypes, 1F-1F, 1F-1S, 1S-1S, 1S-2, 1F-2 and 2-2, were found. The allele frequencies were for Gc 1F;0.518, for Gc 1S;0.312 and for Gc 2;0.170, respectively. The heterogeneity rate was 0.5065.

Introdnction

In 1959, Hirschfeld discovered the group-specific component(Gc) system in human sera, dividing it into three main types; Gc1-1, Gc2-1, and Gc2-2 (Putnam 1977, and Fertakis et al. 1971). And Daiger et al(1975) discoverered that Gc binds vitamin D.

Recently, Viau and Constans (1977) found 3 phenotypes, Gc 1F-1F, 1F-1S and 1S-1S in Gc 1-1 phenotypes and also 2 subtypes Gc 2-1F and 2-1S, in Gc 2-1 phenotypes, by using the isoelectric focusing method on polylamide gel. Later, Constans et al(1978a) showed that this technique has a great resolving power to discriminate some Gc variants. This method is capable of distinguishing charge differences in proteins as small as 0.01 PH unit.

We now report a similar situation for the group-specific component(Gc) in Jeju-do population among the unrelated 308 individuals.

Materials and Methods

Thin-layered(1mm) gel isoelectric focusing was made as recommended by LKB(1974, 1977) and Kueppers et al(1979). 3.75g of sucrose (RNase free saccharose, Merck) was dissolved in 19.5ml

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of distilled water and added 4.0ml of a 29.1% acrylamide solution (Eastman) and 4.0ml of a 0.9% bisacrylamide solution (Eastman). Ampholine (LKB) carrier ampholytes of pH range 4-6(0.4ml) and 1.1ml of Ampholine carrier ampholytes of PH range 3.5-5 were added.

The mixture was stirred and after the addition of 0.01ml of tetramethylethylenediamine(TEMED, Eastman) was deaerated, 1.0ml of 1% ammmonium persulfate was added. And the solution was filled into the gel mold with a plastic syringe. After complete polymerization(about an hour at room temperature 20-5℃) the gel was stored in refrigerator(at 4℃) overnight and was used next morning.

Acryl-and biacrylamide solution were kept in refrigerator at 4℃ and changed every two weeks. Freshly made ammonium persulfate was used.

Isoelectrofocusing was performed with an LKB Multiphor (2117) Electrofocusing apparatus. One strip of filter paper(Whatman 3MM. 10×24mm) was soaked in 1N H3P04 and was used as an anodal electrode. Four strips of filter paper were soaked in 1N NaOH and were used as a cathodal electrode.

After the power supply being set an 800V. 50 mA, the prerun was continued for 75 minutes. Serum samples were placed on the gel surface close to the cathodal electrode, after soaking the 6×10mm rectangles of Whatman 3MM filter paper with serum, and the run was continued for 30 minutes. The filter paper was removed from the gel surface and main run was continued for 180 minutes.

After the run(total; 285 minutes), the gel was stained in Coomassie brilliant blue solution for 30 minutes at 60-65℃. The staining solution was consisted of 400ml of distilled water in which was dissolved 72g trichloracetic acid(TCA) and 22g of sulfosalicylic acid and 100ml of methyl alcohol was added with 0.6g Coomassie brilliant blue(Eastman). After the stain, the gel was destained in a solution of 750ml of ethyl alcohol, 240ml of glacial acetic acid, and 1950ml of distilled water. The destaining solution was changed for several times until the background was clear.

Results and Discussion

6 Kinds of phenotypes were classified as shown in Fig. 1. Among them Gc 1F-1F, Gc 1F-1S were most popular phenotypes observed in 30.52%, 29.54% of 308 sera examined, respectively. And the next common phenotypes were Gc 1F-2, Gc 1F-1S observed in 12.99%, 12.34%, respectively. The less common phenotype, Gc 2-2 was observed in 6.49%.

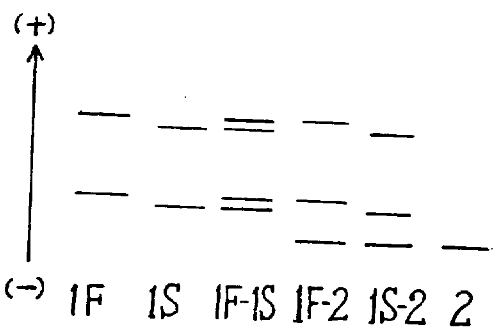
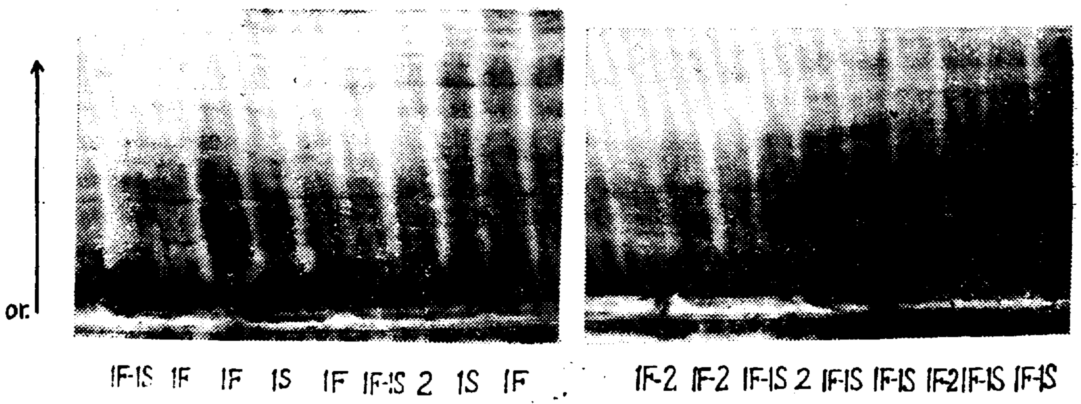


Fig.1. a. A diagram of 6 kinds of phenotypes

According to the report of the First International Workshop on Gc, a total of 30 different group-specific component alleles or variants were identified in the survey; there were 21 double-band variants and 9 single-band variants(Constans and Cleve, 1979) (Fig. 2).



b. Gc phenotypes by Isoelectric focusing

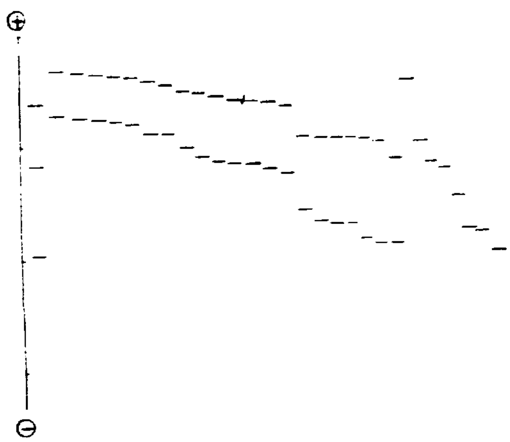


Fig. 2. Diagramatic presentation of Gc phenotype as observed by isoelectrofocusing.
(from Constans et al 1979)
(from left to right)
(1) 2-1F (2) 1A9 (3) 1A8 (4) 1A7 (5) 1A6
(6) 1A5 (7) 1A4 (8) 1A3 (9) 1A2 (10) 1F
(11) 1A1 (12) 1S (13) 1C1 (14) 1C2 (15) 1C3
(16) 1C4 (17) 1C5 (18) 1C6 (19) 1C7 (20) 1C8
(21) 1C9 (22) 1C10 (23) 2A6 (24) 2A5 (25) 2A4
(26) 2A3 (27) 2A2 (28) 2A1 (29) 2 (30) 2C1
(31) 2C2

In this study, we couldn't find any other variants, though PAGIF(polyacrylamide gel isoelectric focusing) was capable of distinguishing charge differences in proteins as small as 0.01 pH unit(Kueppers 1976. Constans et al 1978a, 1978b).

Two Gc 1 subtypes were observed as Constans and Viau(1977). According to the electrophoretic mobilities, we could find the sets of one, two, three and four bands, In Gc 1 subtypes, the more anodal band is called Gc 1F and the cathodal one is called Gc 1S(Constans et al, 1978a, 1978b). The bands of Gc proteins were identified through the pH measuring of the gel and through noticeing the band patterns. We could read the Gc protein bands between pH 4.8 and 5.1. In some cases it was very difficult to detect the Gc 2 bands that were complexed with the tip of the sample applying rectangle filter paper.

The gene frequencies were: Gc 1F; 0.158, Gc 1S; 0.312, Gc 2; 0.170(Table 1). The higher freqcency of the Gc 1F gene in relation to the one of the Gc 1S gene leads to a result similar to the Japanese population (Omoto et al. 1978, Ishimoto et al, 1979) and would make up a characteristic of the Asian populations(Table 2). The same remark appeared in Fig. 3 in which the Japanese population showed near the Jeju-do population.

Table 1. Allele frequencies of Gc of Jeju-do population.

	Total	1F1F	1S1S	1F1S	1F-2	1S-2	2-2
Percent	100.00	30.52	12.34	29.54	12.99	8.12	6.49
Obs.	308	94	38	91	40	25	20
Exp.	308	82.644	29.982	99.555	54.245	32.673	8.901

$X^2 = 23.822$ Gene frequencies: 1F=0.518
1S=0.312
2=0.170

Table 2. Gc phenotypes and allele frequencies by the countries and populations.

Countries or populations	Total	Phenotype Gc1 1F1F	Gc1 1F1S	Gc1-2 1S-1S	Gc1-2 1F-2	Gc1-2 1S-2	Frequencies Gc2 2-2	Variants
Korean(Seoul)	122	64		42			16	
〃(Jeju-d0)	308	94	91	38	40	25	20	
Japan	305	66	69	17	76	53	13	J-1F;7 J-1S;2 J-2;2
〃	1,347	710		485			83	J-1;47 J-2;19 J-J;19
〃	1,041	232	248	56	248	128	68	Ja-1F;20 Ja-1S;7 Ja-2;12 Ja-Ja;1 Jb-1F;1 Jb-1S;3 Jc-1F;7 Jc-S;2 Jc-2;4 Jd-1F;1 Jd-2;1 Mie-1F;2
〃	61	31		22			4	4
Chinesse	54	25		19			7	3
Israel								
North Africans	109	54		49			6	
Indians	71	37		28			6	
Cochin	53	32		19			2	
Persian	149	91		43			15	
Afghanistan	141	72		54			15	
Senegal	357	227	48	9	29	9	—	Ab-1F;14 Ab-1S;3 Ab-2b;2 2b-1S;2 2b-1F;7 1b-1F;5 1b-1S;2
Nigerian								
Habe	103	88		15			—	
Fulani	100	90		10			—	
Central Africa (Pygmy)	267	90	59	11	19	4	2	Ab-1F;16 Ab-1S;7 Ab-2;4 2a-2;3 Ab-2a;2 2a-2a;2 2a-1S;38 2a-1F;10
Nigerians	77	72		5			—	
Central African (Pygmy)	143	108		22			2	12
Gongo(Pygmy)	60	27		7			—	15
Greece	600	336		231			33	
〃	543	304		199			40	
Iceland	369	183		157			29	
Norway	292	161		108			23	
France	290	1	26	76	17	119	51	

Germany								
(Munich, Bavaria)	440	8	75	157	36	130	32	2
(Marburg, Hesse)	146	4	27	42	17	50	6	
Italians	147	3	29	51	9	42	13	
Belgians	267	9	41	82	30	85	20	
Eskimo(Canadian)	67	34		26			7	
U. S. White	122	63		49			10	
U. S. Black	144	116		25			3	
U. S. Chiness	117	72		36			9	
Amerindian								
Navajo	245	235		9			1	
Trio Indian	413	287		107			19	
Wajana Indian	279	214		61			4	
Chippewa Indian	62	28		19			2	Chip-1;10 Chip-2;3
Bolivia(Amerindian)	253	16	73	101	12	42	4	Am-1S;5
U. S. White	110	3	19	37	8	32	11	
U. S. Black	492	271	98	14	72	15	7	Ab-1F;9 Ab-1S;3 Ab-2;3
New Guinea	1,816	662		554			199	Ab-Ab;31 Ab-1;179 Ab-2;191
Australian Aborigine	74	42		18			5	Ab-Ad;1 Ab-1:7 Ab-2;1

Allele Frequencies

Countries or populations	Gc1	Gc1F	Gc1S	Gc2	Variants	Author	Year
Korean(Seoul)	0.697			0.303		Kitchin et al	1964
〃 (Jeju-do)		0.518	0.312	0.170		Oh et al	1980
Japan		0.4656	0.2590	0.2574	GcJ;0.0180	Omoto et al	1978
〃	0.7246			0.2487	GcJ;0.0267	Kuwata et al	1978
〃		0.4759	0.2406	0.2546	Ja;0.0197 Jb;0.0010 Jc;0.0063 Jd;0.0010	Ishmoto et al	1979
〃	0.721			0.246	GcV;0.033	Daiger et al	1977
Chinese	0.657			0.315	GcV;0.028	Daiger et al	1977
Israel							
North Africans	0.720			0.280		Kitc et al	1964
Indians	0.718			0.282		〃	
Cochin	0.783			0.217		〃	
Persian	0.755			0.245		〃	
Afghanistan	0.702			0.298		〃	
Senegal		0.780	0.115	0.053	Ab;0.027 1b;0.010 2b;0.015	Constans et al	1978b
Nigerian Habe	0.9272			0.0728		Cleve et al	1961
Fulani	0.950			0.0500		〃	
Central Africa (Pygmy)		0.584	0.191	0.064	Ab;0.054 2a;0.100	Constans et al	1978a
Nigerians	0.967			0.0325		Kitchin	1964
Central African (Pygmy)	0.874			0.080	GcV;0.046	Daiger et al	1977
Congo(Pygmy)	0.633			0.125	GcV;0.245	〃	

Greece		0.752		0.248		Fertakis et al	1971
〃		0.743		0.257		Blumberg et al	1964
Iceland		0.710		0.290		Karlsson et al	1980
Norway		0.740		0.260		Hirschfeld et al	1960
France	0.077		0.512	0.410		Constans et al	1978a
Germany (Munich, Bavaria)	0.1443		0.5920	0.2614	GcV;0.0023	Cleve et al	1978
(Marburg, Hesse)	0.1781		0.5514	0.2705		〃	
Italians	0.1497		0.5884	0.2619		〃	
Belgians	0.1670		0.543	0.290		Hoste	1979
Eskimo(Canadian)		0.7015		0.2385		Cleve et al	1961
U.S. White		0.7172		0.2828		〃	
U.S. Black		0.8924		0.1076		〃	
U.S. Chinese		0.7693		0.2307		〃	
Amerindian Navajo		0.9765		0.0235		〃	
Trio Indian		0.8245		0.1755		Geerdink et al	1974
Wajana Indian		0.8763		0.1237		〃	
Chippewa Indian		0.685		0.2100	Gc Chip;0.105	Cleve et al	1963
Bolivia(Amerindian)	0.231		0.636	0.122	Gc Am;0.009	Constans et al	1978a
U.S. White	0.149		0.572	0.279		Kueppers et al	1979
U.S. Black	0.732		0.147	0.106	GcAb;0.015	〃	
NewGuinea		0.5170		0.2621	GcAb;0.2203	Kitchin et al	1972
Australian Aborigine		0.736		0.196	GcAb;0.068	Cleve et al	1963

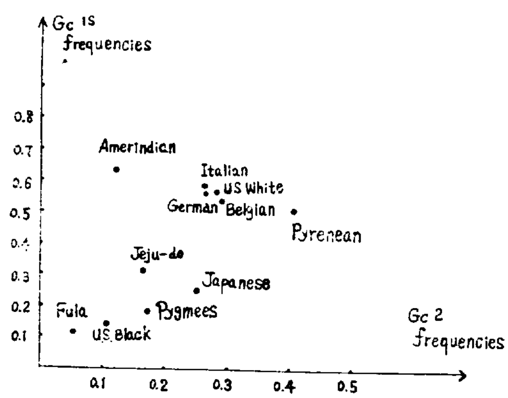


Fig. 3. The repartition of some population samples according to the Gc1s and Gc2 gene frequencies revealed their anthropological and geographical differences (from Gonstans et al 1978 and modified)

We were much interested in which Pygmy group came very significantly near the Jeju-do population. Central Africa Empire is far apart from Jeju-do, Korea. And the weather, the living and eating habit are quite different to each other. It is much doubt that this convergency phenomenon can be explained with which the camera eyes of higher vertebrates and those of mollusks like squid, converge one another, because all they move fast.

In Japanese population group, Omoto et al(1978) and Kuwata et al(1979) reported relatively high allele frequencies of Gc J variants(Gc J=0.0180~0.267). Omoto et al(1978) told that further data of other asiatic populations are needed to confirm whether the distribution of Gc subtypes found in their study along with the occurence of Gc J is characteristic of Mongoloid groups of Asia. Because we didn't use the isoelectrofocusing-immunofixation method, we couldn't discuss about that. But we feel the need to try to use the immunofixation method for further study.

Gc 1 (1F+1S) frequency was very high(0.83) compared with previous study collected blood samples from Seoul by Kitchin et al(1964, Gc 1; 0.679), but Gc 2 frequency was significantly low (0.17) compared with that(0.303). We can't explan whether Jeju-do population is different from Seoul population in Gc alleles frequencies, because of the shortage of the data. More data are needed.

In Gc 2 frequency, Jeju-do population(0.170) was similar to those of Trio Indians of Surinam (0.1755) and of Australian Aborigines(0.196), but was quite different from those of all African populations(average; 0.05446), of France population(0.410), of Eskimo population (0.2985) and of Afghanistan population(0.298).

According to the Table 2, in Israeli populations, the allele frequencies are different from one another with the districts. In Greek populations, the gene frequencies are quite different from one another with the districts, too. As a result, it is able to say that a certain allele frequency can be different with the districts, even in a country.

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〈國文抄錄〉

韓國人에서의 Group-Specific Component(Gc)의 Polymorphism에 관한 硏究

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濟州島人 集團에서 Polyacrylamide gel isoelectric focusing을 利用하여 血淸中의 Group-Specific Component(Gc)의 Polymorphism에 관한 연구에서 다음과 같은 結果를 얻었다.

1. 濟州島人 集團에서 Gc의 Subtype은 1F-1F, 1F-1S, 1S-1S, 1F-2, 1S-2 및 2-2의 6가지 Phenotype으로 나타났다.

2. 총 308명을 대상으로 한 各 Subtype의 分布는 1F-1F; 94명(30.52%), 1F-1S; 91명(29.54%), 1F-2; 40명(12.9%), 1S-1S; 30명(12.34%), 1S-2; 25명(8.12%), 2-2; 20명(6.49%)의 순서이었다.

3. Allele frequency는 각각 Gc 1F=0.518, Gc 1S=0.312, Gc 2=0.170이었다.

4. Heterogeneous rate는 0.5065이었다.