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Existence of a phosphoglucomutase enzyme polymorphism in Asellus aquaticus (L.) (Crust. Isopod.)

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Genetica. — *Existence of a phosphoglucomutase enzyme polymorphism in* Asellus aquaticus (L.) (*Crust. Isopod.*) (*). Nota di PAOLA LUCARELLI, ELISA ANNA FANO e GIOVANNA TADINI VITAGLIANO, presentata (**) dal Socio G. MONTALENTI.

RIASSUNTO. — Esistenza di un polimorfismo enzimatico relativo alla fosfoglucomutasi in *Asellus aquaticus* (L).

È descritto un polimorfismo enzimatico in *Asellus aquaticus*. Tale polimorfismo concerne la fosfoglucomutasi. I dati ottenuti sono in favore dell'ipotesi che il polimorfismo sia controllato da un singolo locus genico con due alleli codominanti (PGM^1 e PGM^2).

Phosphoglucomutase is a key enzyme for carbohydrate metabolism since it catalyzes the G–1–P $\rightleftarrows$ G–6–P reaction. It has been found in all the examined animals and in the majority of cases, including man, it reveals an electrophoretic polymorphism [1, 2, 3, 4, 5, 6, 7, 8].

In the present note the results are reported of a preliminary investigation dealing with this enzyme in *Asellus aquaticus*, an isopod crustacean widely spread in paleo–artic region.

MATERIAL AND METHODS

Eight different natural populations of *Asellus aquaticus* (L.) from various areas were examined. In some of these populations the investigation was repeated several times at time intervals and 2003 individuals were studied.

In said material the existence of an electrophoretic polymorphism for PGM was looked for, using the method by Spencer and Harris [1], in which some slight changes had been introduced. For each examined individual, a tiny filter–paper square (Whatman 3) imbued with the crustacean homogenate was inserted in the plate. The homogenate was obtained by crushing the entire animal into 0.01 ml of buffer employed for preparing the gel.

RESULTS

The *Asellus aquaticus* homogenates can be classified in three different types on the basis of the pattern they show by means of the electrophoretic technique we employed. The three phenotypes are represented in fig. 1 and have been indicated as 1,2 and 1–2, repectively.

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(**) Nella seduta dell'8 marzo 1975.

Both 1 and 2 phenotypes show only one band, having a different anodic velocity, whereas the 1–2 phenotype reveals both bands. These three phenotypes were observed in all the examined populations.

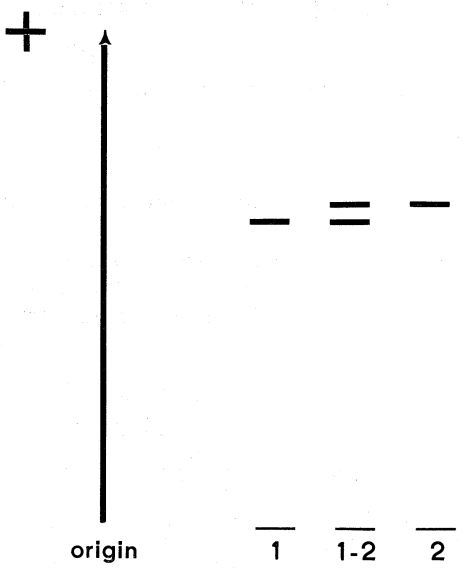

Fig. 1. – Diagram of starch gel showing cmponents observed in homogenates from individuals of PGM types 1, 1–2 and 2.

In Table I the preliminary data are reported, concerning the enzyme formal genetics, which has been obtained by examining the offspring of 14 families with both parents being known.

TABLE I.

PGM *phenotype distribution in 14 cross-breeds* (*)

Types of cross-breeds	Offspring PGM phenotypes		
	1	1–2	2
1 × 1–2	22	18	—
1 × 2	—	12	—
1–2 × 1–2	3	11	6
1–2 × 2	—	9	12
2 × 2	—	—	44

(*) The individuals employed for the above cross-breeds belonged to a sample collected in the Sarno river (Naples).

DISCUSSION

On the basis of the electrophoretic pattern, the result of the performed cross-breeds as well as of the relative frequencies of the various phenotypes in the examined populations, the most likely genetic assumption is that the enzyme is controlled by a single locus with two codominant alleles, indicated by us as PGM^1 and PGM^2.

The PGM^1/PGM^1 and PGM^2/PGM^2 homozigotes correspond to phenotypes 1 and 2 respectively, whereas the 1–2 phenotype corresponds to PGM^1/PGM^2 heterozygote.

On the basis of the data obtained and the proposed assumptions, Table II has been worked up, in which the phenotype and gene frequencies, pertaining to the PGM locus in the various examined populations, are reported.

TABLE II.

Gene and phenotype frequencies of phosphoglucomutase (PGM) *in natural populations of* Asellus aquaticus.

Place	Date	Total	Phenotypes (a)			Alleles (a,b)	
			PGM 1	PGM 1–2	PGM 2	PGM^1	PGM^2
Sarno (Naples) . .	July 1970	388	72	189	127	333	443 (0.571)
	September 1970	596	117	314	165	548	644 (0.540)
	October 1971	45	9	23	13	41	49 (0.544)
Nettuno (Rome) . .	April 1971	15	2	10	3	14	16 (0.533)
Fiumicino (Rome) . .	December 1970	147	28	80	39	136	158 (0.537)
	February 1971	119	27	59	33	113	125 (0.525)
	March 1971	119	28	59	32	115	123 (0.517)
Bufalotta (Rome) . .	May 1971	26	3	12	11	18	34 (0.654)
Utrecht (Holland) . .	October 1970	147	91	51	5	233	61 (0.207)
	December 1972	105	31	41	33	103	107 (0.509)
Mälaren (Sweden) . .	November 1971	72	59	13	—	131	13 (0.091)
Fyrisån (Sweden) . .	October 1970	76	72	4	—	148	4 (0.026)
	November 1971	78	53	25	—	131	25 (0.160)
	October 1970	60	—	7	53	7	113 (0.942)
Payep (Sweden) . .	November 1971	10	—	6	4	6	14 (0.700)

(a) Absolute frequencies; (b) The frequencies of the PGM^2 allele are reported in parentheses.

In all the cases the phenotype distribution was in agreement with expectation according to Hardy–Weinberg equilibrium.

Moreover, it clearly transpires that this polymorphism shows a considerable variability among the examined populations: the PGM^2 allele frequencies range from 0.091 (Mälaren population) to 0.942 (Pajep population).

References

[1] SPENCER N., HOPKINSON D. A. and HARRIS H. (1964) – *Phosphoglucomutase polymorphism in man*, « Nature », *204*, 742.

[2] DAWSON M. and JAEGER S. (1970) – *Heterogeneity of phosphoglucomutase*, « Biochem. Genetics », *4*, *1*.

[3] SELANDER R. K., YANG S. Y., LEWONTIN R. C. and JOHNSON W. E. (1969) – *Genetic variation in the horseshoe crab* (Lymulus polyphemus), *a philogenetic relic*, « Evolution », *24*, 402.

[4] BULLINI L., COLUZZI M., GIRONI A. M. and MORELLINI M. (1970) – *Phosphoglucomutase polymorphism in* Aedes aegypti, « Parass. », *12*, 27.

[5] COLUZZI M., BULLINI L. and BIANCHI BULLINI A. P. (1971) - *Phosphoglucomutase* (PGM) *allozymes in two forms of the mariae complex of the genus* Aedes, « Biochem. Genetics », *5*, 253.

[6] TRIPPA G., SANTOLAMAZZA C. and SCOZZARI R. (1970) – *Phosphoglucomutase locus in* Drosophila melanogaster: *linkage and population data*, « Biochem. Genetics », *4*, 665.

[7] SELANDER R. K., HUNT S. W. and YANG S. Y. (1969) – *Protein polymorphism and genic heterozygosity in two European subspecies of the house mouse*, « Evolution », *23*, 379.

[8] SELANDER R. K. and YANG S. Y. (1969) – *Protein polymorphism and genic heterozygosity in a wild population of the house mouse* (Mus musculus), « Genetics », *63*, 653.