HAEMOGLOBIN POLYMORPHISM IN ITALIAN WATER BUFFALO

Polimorfismo de la hemoglobina en el búfalo italiano de agua

Polymorphisme de l'hémoglobine chez le buffle italien d'eau

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Water buffalo haemoglobin upon electrophoresis separates into two bands (VELLA, 1958; SEN *et al.*, 1966; NAIK and SUKUMARAN, 1966; MAKAVEEV, 1968; ABE *et al.*, 1969; GRANCIU *et al.*, 1972). No clear cut individual differences have been reported so far, with the exception of KHANNA and BRAEND (1968) which found 4 animals out of 507 having three bands (pattern this explained assuming that a mutation occurred at the β chain *locus*) and 2 showing a relationship between A_1 and A_2 bands different from the common type (pattern this assumed to be caused through heterozygosity at a modyfying *locus*). In this species two kinds of α chains and only one kind of β chain are synthetized (BALANI and BARNABAS, 1965). The two kinds of α chains are controlled by two structural *loci* originated by duplication (KITCHEN, 1969).

We tested one hundred and fifty Italian water buffalo by starch gel electrophoresis at pH 8.7 with the technique of FIORENTINI *et al.* (1967) and we found 18 animals (12 per cent) differring from the remaining ones in having the slower band very faint (Fig. 1). The same phenomenon, even though less frequently, was observed by ABE *et al.* (1969) and NAIK and SUKUMARAN (1966). This characteristic when present in the offspring was present also in at least one of its parents, thus suggesting the possibility that it was under genetic control. We called *AB* the type of animals with the slow band very faint and *B* the type of animals with a comparatively more visible slow band. In order to know which of the subunits of the hemoglobin molecule was responsable for the observed difference, α and β chains from animals of type *AB* and *B* were separated on starch gel by the technique of CHERNOFF and PETTIT (1964). The results obtained are shown in Fig. 2. No variability is visible within the β chains, but in relation to α chains animals

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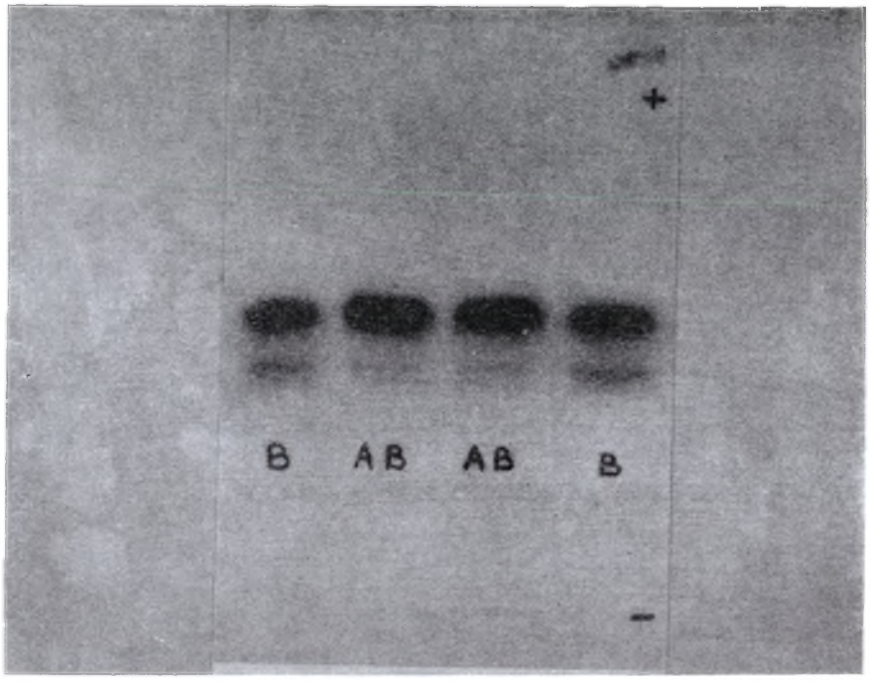

FIG. 1. Electrophoretic pattern of AB and B Italian water buffalo haemoglobin B Italian water buffalo haemoglobin types

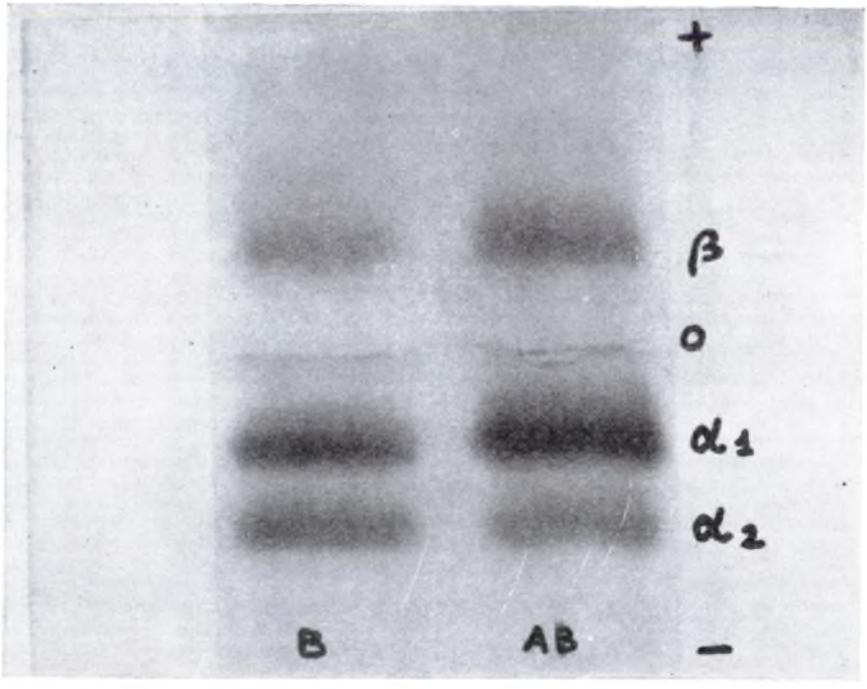

FIG. 2. Electrophoretic separation of α and β chains from B and AB Italian water buffalo haemoglobin types

AB and *B* appear different, the former having α_1 chains denser than the corresponding ones of *B* and α_2 chains lighter than the corresponding ones of *B*.

The tentative hypothesis which we advance to explain these results is that of the two *loci*, originated by duplication (KITCHEN, 1969), which in water buffalo control the synthesis of α chains, one (which we call α_1) synthetizes α_1 chains and the other (which we call α_2) synthetizes α_2 chains; α_1 *locus* is not polymorphic, at least in our experimental conditions; α_2 *locus* instead has the allele α_2^A and α_2^B; the former synthetizes chains electrophoretically indistinguishable from those α_1 and the latter (α_2^B) synthetizes α_2 chains.

According to this mechanism, animals of phenotype *AB* would be heterozygous at the α_2 *locus* (α_2^A/α_2^B) and animals of phenotype *B* would be homozygous for the α_2^B allele (α_2^B/α_2^B). The few family data that so far it has been possible to collect, are compatible with the mechanism of inheritance tentatively proposed (Table 1).

TABLE 1

INHERITANCE OF AB AND B ITALIAN WATER BUFFALO HAEMOGLOBINS

N	Mating type	*B*	*AB*	*AA*
26	B × B	26	—	—
9	B × AB	5	4	—
1	AB × AB	1	—	—

The fact that genotype α_2^A/α_2^A, anticipated by the hypothesis, has not been observed may be attributed to the very low frequency of the α_2^A allele which, on 50 randomly picked animals, was estimated around 0.06. Further work to confirm and extend these studies are in progress.

SUMMARY

150 Italian water buffalo haemoglobin samples were tested by starch gel electrophoresis at pH 8.7.

18 animals AB (with the slow band very faint) and 132 animals B (with a comparatively more visible slow band) were found. Alpha and beta chains from AB and B animals were separated on starch gel. Variability was visible within the alpha chains only. The few family data so far available suggest that of the two *loci* which in this species control the synthesis of alpha chains, only one (which it was called α_2) is polymorphic.

RESUMEN

Fueron experimentados por electroforesis por gel almidón a pH 8,7 150 muestras de hemoglobina de búfalo acuático.

Se hallaron 18 animales AB (con la banda lenta muy pálida) y 132 animales B (con una banda lenta comparativamente más visible). Se separaron en gel almi-

dón las cadenas alfa y beta de animales AB y B. La variabilidad fue visible únicamente en las cadenas alfa. La parquedad de datos familiares disponibles hasta el momento sugiere que de los dos *loci* que controlan en esta especie la síntesis de las cadenas alfa, sólo una (que ha sido llamada α_2) es polimórfica.

RESUME

150 échantillons d'hémoglobine de buffles d'eau italiens ont été soumis à l'électrophorèse en gel d'amidon à pH 8,7. 18 animaux AB (avec la bande lente très faible) et 132 animaux B (avec la bande lente comparativement plus visible) ont été trouvés.

Les chaînes alpha et béta d'animaux AB et B ont été séparées en gel d'amidon. On a observé des variations individuelles dans les chaînes alpha seulement. Les peu nombreuses données de famille disponibles jusqu'alors suggèrent que des deux *loci* qui contrôlent dans ces espèces la synthèse des chaînes alpha seulement une (qui a été appelée α_2) est polymorphique.

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