ALBUMIN PHENOTYPES IN TURKEYS[1]

INDALECIO R. QUINTEROS[2], R. W. C. STEVENS, C. STORMONT AND V. S. ASMUNDSON

Departments of Veterinary Microbiology and Poultry Science, University of California, Davis

Received April 28, 1964

IN a search for polymorphisms in plasma proteins of turkeys, we observed differences in the electrophoretic patterns of proteins which migrated in the region of the albumins.[3] On tracing the pedigrees of the birds it became apparent that the alleles for the three albumin types were segregating only in descendants from a cross between the domestic species (*Meleagris gallopavo*) and the ocellated turkey (*M. ocellata*). The purpose of this report is to describe the albumin phenotypes, to present data on their inheritance and to trace the origin of the two alleles in the population under study.

MATERIALS AND METHODS

Plasma samples were obtained from citrated (2 percent sodium citrate + 0.5 percent NaCl) blood samples drawn from domestic turkeys, ocellated turkeys and descendants obtained from crossing the domestic turkey with the ocellated turkey. The hybridization of the two species is described in a report by LORENZ, ASMUNDSON and WILSON (1956). All birds were approximately 16 weeks of age at the time of sampling. The plasma was kept at —20°C when not in use.

The samples were subjected to horizontal starch-gel electrophoresis after the method described by KRISTJANSSON (1963) in a study of pre-albumin phenotypes in pigs. This method was also used in this laboratory in the detection of three albumin phenotypes in horses (STORMONT and SUZUKI 1963). The procedure used in the present study differed from that described by KRISTJANSSON in the following ways. The percent of hydrolysed starch (Connaught Medical Laboratories, Toronto) used in preparing the gels was increased to 15 and the citric acid was increased to 0.005M, bringing the pH of the gel buffer to 6.8. The dimensions of the gels were 21.7 × 12 × 0.6 cm. The filter paper strips used for loading plasma were inserted 4 cm from the cathode end of the gels. The runs were stopped and the gels were stained when the borate boundary had migrated 12 cm beyond the point of insertion. Attention is also called to the methods used by MCINDOE (1962) which defined three serum albumin phenotypes in the domestic fowl.

RESULTS AND DISCUSSION

Three albumin phenotypes named A, B and AB were observed as shown in Figure 1. Each of the phenotypes A and B was characterized by two rather thick

[1] Supported in part by National Science Foundation Grant G6109 and by the Agricultural Institute of Canada.

[2] Visiting Research Associate from the Department of Pathological Anatomy and Physiology, Faculty of Veterinary Sciences, National University of La Plata, La Plata, Argentina.

[3] SMITHIES (1955) proved that the major protein component of human serum in starch gel had been correctly identified as albumin. MCINDOE (1962) demonstrated the same zone in chicken serum to be albumin by its solubility characteristics. By analogy the major protein components of the serum of horses (ASHTON 1958b; STORMONT and SUZUKI 1963), cattle, sheep, and goats (ASHTON 1957, 1958a; ASHTON and MCDOUGALL 1958), and pigs (KRISTJANSSON 1963) have been designated as albumin. From quantitative considerations, the comparable protein fraction of turkey serum is herein labelled albumin.

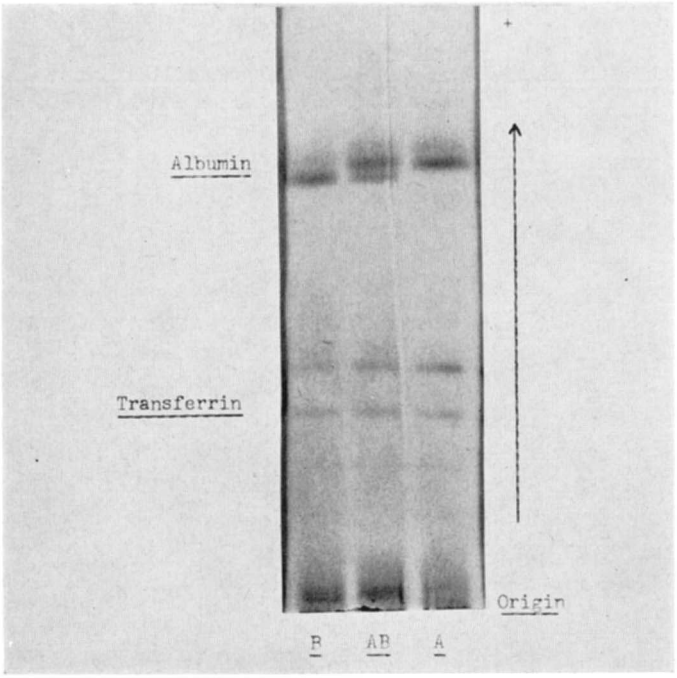

FIGURE 1.—Starch gel on three turkey plasma samples showing from left to right the resolution, positioning and relative staining capacity of the albumin bands or zones in the phenotypes B, AB and A. Also indicated in the photo is the position of two bands believed to be transferrins. No polymorphism was observed in the transferrins of turkeys.

bands, the slowest of which stained the most intensely. The slowest of the two bands in phenotype A migrated at a rate which was synchronous with the fastest of the two bands in phenotype B. Phenotype AB, which exhibited three bands, appeared as a compound of phenotypes A and B, in which the slowest and intermediate bands stained more intensely than the fastest moving band. Phenotype AB could be readily simulated by performing runs on samples made by pooling equal parts of A and B plasma.

These observations suggested that the three albumin phenotypes are controlled by a pair of codominant autosomal alleles, designated here as Alb^A and Alb^B, each controlling two bands or zones with the slowest of the two bands controlled by Alb^A, being synchronous in its rate of migration with the fastest of the two bands controlled by Alb^B.

The family data are summarized in Table 1. Unfortunately there were no birds of phenotype B in the present mating flock. Nevertheless the A × AB and AB × AB matings provided a test of the genetic theory. As may be noted, the ratio of 38 type A to 41 type B offspring in the A × AB matings closely approximated the expected 1:1. The 3:17:6 ratio in the AB × AB matings does not deviate significantly from the expected 1:2:1. As expected, all offspring from

TABLE 1

Inheritance of albumin phenotypes (observed/expected)

Matings	Offspring of phenotypes			P of χ^2
	A	AB	B	
A × A	99/99	0	0	
A × AB	38/39.5	41/39.5	0	>0.5
AB × AB	3/6.5	17/13	6/6.5	>0.05

A × A matings were of type A. Analogous results were obtained by McINDOE (1962) in studies of the inheritance of three albumin phenotypes of domestic fowls and by STORMONT and SUZUKI (1963) in studies of the inheritance of three albumin phenotypes in horses.

The pedigrees of all birds of phenotypes AB and B traced to the hybridization of the domestic species (*M. gallopavo*) with the ocellated turkey (*M. ocellata*) described by LORENZ *et al.* (1956). This observation in conjunction with the observation that all birds (150 from five different breeding lines) of the species *M. gallopavo* were of phenotype A suggested that the allele Alb^B in birds of the present mating flock derived solely from *M. ocellata*. Fortunately, plasma samples from the two ocellated males used in the original hybridization were available along with four samples from F_1 hybrids. Both ocellated males were of phenotype B, whereas the four F_1 hybrids were all of phenotype AB. Samples from four hybrids derived from backcrossing F_1 females with the ocellated males were also available. Two of the four samples were of phenotype B and two were of phenotype AB. Only one sample was available from the backcross of F_1 × *M. gallopavo* and it was of type A. Likewise, only one sample was available from the F_2 generation. It was of phenotype AB. Thus, this additional evidence fortifies the conclusion that allele Alb^B in the present breeding flock derived solely from the species *M. ocellata*.

The observation that all birds of the species *M. gallopavo* so far tested are of phenotype A suggests that the allele Alb^A is at or near fixation in that species. Whether the allele Alb^B is at or near fixation in *M. ocellata* remains to be seen. These observations agree with those of BECKMAN, CONTERIO and MAINARDI (1963), who studied the serum protein patterns of 11 avian species hybrids and observed that when the main, fast-migrating serum protein components differed, both forms were present in the hybrid. They commented that "most individuals of the two parental species are (seemingly) homozygous for the genes controlling the synthesis of the proteins in question."

The *Alb* locus should provide a convenient marker for studies of production traits in the hybrids derived from the original crossing of *M. gallopavo* with *M. ocellata*. Whether the two *Alb* alleles may have effects on conalbumins or other egg proteins is an object of further study.

We thank MR. B. G. MORRIS for his technical assistance in this study.

SUMMARY

Three albumin phenotypes named A, B and AB were distinguished in the process of performing starch-gel electrophoresis on plasma samples from hybrid turkeys derived originally from crossing the two species, *Meleagris gallopavo* and *M. ocellata*. It is proposed that the three phenotypes are controlled by a pair of codominant autosomal alleles Alb^A and Alb^B. It is further suggested that Alb^A and Alb^B in the hybrids were derived, respectively, from *M. gallopavo* and *M. ocellata*.

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