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Polymorphic protein expression (profile) in numigall*

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Ten protein and enzyme polymorphic systems, viz. haemoglobin, albumin, transferrin, adenosine deaminase, adenylate kinase phosphoglucomutase, esterase-D, glyoxalase, alkaline phosphatase and amylase were studied in numigall (guinea fowl × chicken hybrids) to assess structural gene expression and regulatory gene divergence between the parental species. The investigation revealed presence of both the maternal and paternal electrophoretic components in case of adenosine deaminase, alkaline phosphatase, amylase, albumin and transferrin although no clear differences could be identified for haemoglobin and glyoxalase. Esterase-D and adenylate kinase phenotypes showed a dominance of the chicken type.

Polymorphic protein expressions in hybrids provide valuable information regarding genetic differences between the parental species and genetic organisation mechanisms in the new genomic combination. The approach is particularly interesting since it also provide an indirect assessment of regulatory gene differences between the two species. Earlier investigation of polymorphic proteins and enzymes of Numigall (*Numia meleagris* × *Gallus. g. domesticus*) revealed full expression of maternal and paternal allelic products; no strong evidence for break-down in the regulatory mechanism responsible for expression of polymorphic genes were obtained[1-4]. Present investigation is an extension of such studies; results for certain hitherto unexplored polymorphic protein and enzyme systems of numigall are presented.

Materials and Methods

Numigalls were raised by artificial insemination of guinea fowl females with male chicken (White Leghorn) semen. Electrophoretic pattern of haemoglobin, albumin and transferrin were studied in starch-gel[5]. While agrose-gel electrophoresis procedures were adopted for the separation of serum alkaline phosphatase[6], amylase[7] and red cell enzymes viz. adenylate kinase, esterase-D, adenosine deaminase, phosphoglucomutase and glyoxalase respectively[8].

Results and Discussion

The relative mobilities of different proteins and enzymes are presented in the Table 1. Electrophoretic profile of numigall glyoxalase, adenylate kinase, phosphoglucomutase, alkaline phosphatase and amylase revealed presence of all parental components in similar staining intensities; no new electrophoretic components were identified. Numigall plasma alkaline phosphatase revealed presence of a thick darkly stained band along with a minor component migrating ahead. While thick major band represented existence of both the parental components, but the minor band was analogus to that of guinea fowl faster component. The diagramatic representation of the observed phenotypes are presented in Fig. 1. The electrophoretic patterns of hybrid proteins, viz. albumin, haemoglobin and transferrin represented gene products of both maternal and paternal contributions. These patterns were also similar to those obtained for electrophoresis of the parental plasma mixture. Results suggest no evidence for regulatory mechanism breakdown, and confirm the earlier findings for haemoglobin[1] and trnsferrin[2]. Investigation of chicken × quail and chicken × turkey hybrids revealed existence of haem-haem interactions and relative preponderance of chicken component[9,10]. But such preponderance was difficult to discern in case of numigall due to similar isoelectric points for the two parental haemoglobins (Fig. 2). Serum albumin was most conservative protein which separate as single major band in homozygote parents revealed two banded phenotype in hybrids (Fig. 3). Similar two banded albumin pattern was also reported for turkey × quail and chicken × quail hybrids[10,11].

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Table 1—Variation in expressions of parental electromorph in numigall

System	Relative mobility (cm) of electromorphis								Type of gene action
	Chicken			Guinea fowl			Numigall		
Adenosine deaminase	Ada_C		4.6	Ada_G		2.0	Ada_C Ada_G	2.0 4.6	Codominant
Adenylate kinase	Ak_C		0.6	Ak_G		0.9	Ak_C	0.7	Dominant
Esterase-D	$Es\text{-}D_C$	(M) (m)	4.4 4.6	$Es\text{-}D_G$	(M) (m)	4.0 4.8	$Es\text{-}D_C$	4.4 4.5	Dominant
Glyoxalase	Glo_C	(M)	2.0 2.7	Glo_G	(M) (m)	2.0 2.7	Glo_{CG} (M) (m)	2.0 2.7	Codominant
Alkaline phosphate	Akp_C		0.6	Akp_G	(M) (m)	0.3 1.5	Akp_{CG} (M) (m)	0.5 1.5	Codominant
Amylase	Amy_C		5.0	Amy_G		4.8	Amy_G Amy_C	4.8 5.0	Codominant
Albumin	Alb_C		7.1	Alb_G		6.8	Alb_G Alb_C	6.8 7.0	Codominant
Hacmoglobin	Hb_C	(M) (m)	1.0 1.7	Hb_G	(M) (m)	0.8 1.7	Hb_{CG} (M) (m)	0.9 1.7	Codominant
Transferrin	Tf_C		1.5 2.0	Tf_G		3.5 4.0	Tf_C Tf_G	1.5, 2.0 3.5, 4.0	Codominant

C—Chicken component; G—Guinea fowl component. M—Major electromorph; m—Minor electromorph.

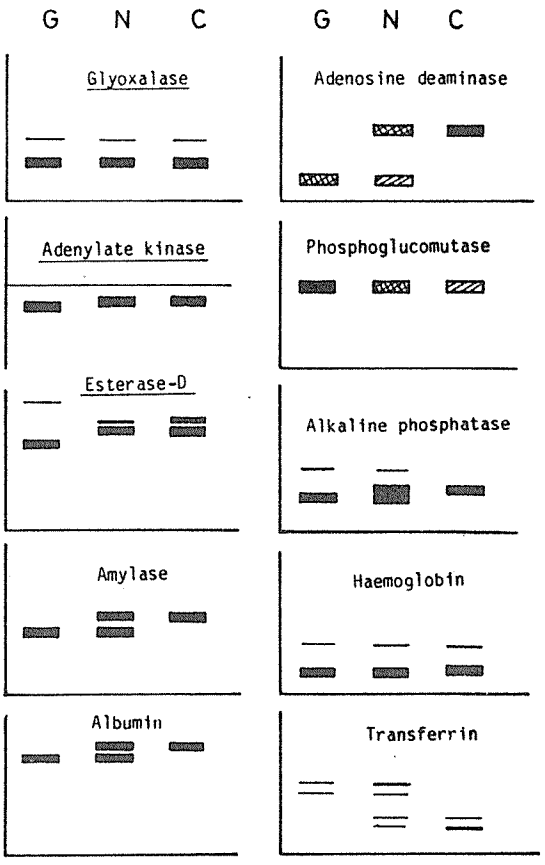

Fig. 1—Schematic representation of Numigall protein/enzyme electrophoretic profile (G, guinea fowl; N, numigall; C, chicken)

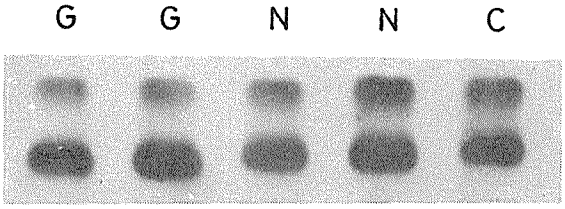

Fig. 2—Electrophoretogram of numigall haemoglobin

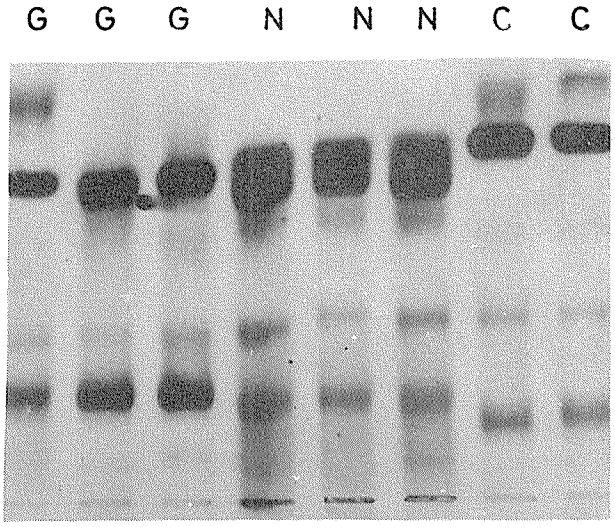

Fig. 3—Electrophoretogram of numigall albumin

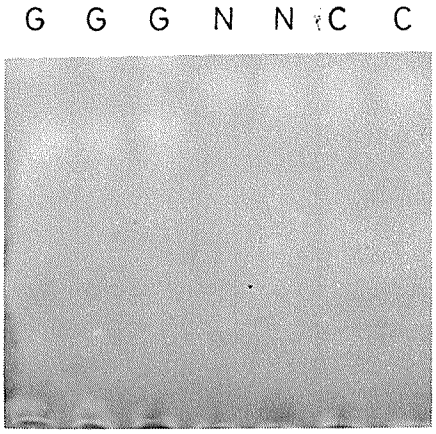

Fig. 4—Zymogram of numigall esterase-D

Present observations show strong regulation of adenylate kinase and esterase-D phenotypic expressions (Fig. 4). Reduced staining intensity observed for adenosine deaminase and phosphoglucomutase suggest reduced substrate reactivity or quantitative variation in the enzyme. This difference in parental component proportions may be a dosage effect[12] as reported in earlier study. Numigall esterase-D and adenylate kinase phenotype showed complete repression of guinea fowl genetic contributions perhaps due to recognition failure of the regulatory elements. Similar unambiguous predominance of quail component was observed for leucine aminopeptidase in chick × quail hybrids[13].

Interaction product of hybrid substances is often associated with hybrid vigour[10]. But conversely it might even interfere with vital cell processes leading to hybrid weaknesses. This could be one of the reason that hybrids often meet early embryonic deaths or die soon after hatching[14]. In case of numigalls only males survive while females undergo embroyonic deaths[4,15,16]. The expression of a structural gene in any organism depends on the regulatory gene apparatus constituting the genome. Even the species showing similar structural genes may differ remarkably with respect to their regulatory genes because of organismal evolutionary differences. Regulatory genes of a species are strongly selected to interact with their own structural genes; there is no reason to suppose that regulatory genes should also cope with structural genes belonging to different species that may have evolved independently[17]. Present comparison of chicken and guinea fowl polymorphic protein/enzyme variants revealed existence of extensive differences in agreement to their different evolutionary histories. Interference in full expression of the parental gene products further indicate existence of significant regulatory gene differences. However, detailed direct studies are suggested for more precise estimates of the existing regulatory gene differences between the two species.

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