Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (First Year)

Subject: Zoology

Paper Code: ZOC 102

Paper Title: Diversity of Chordates and Genetics

Unit: 8

Module Name: Epistasis and Hypostasis-I

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NOTES:

There are two general categories of gene interactions, intralocus and interlocus interactions.

- Intralocus or allelic interactions take place between alleles at the same locus, i.e it takes place between alleles of the same gene.
- Interlocus or non-allelic interactions take place between alleles at different loci.

Interlocus interactions may be divided into two general classes, **epistatic/nonepistatic interactions** and additive or polygenic interactions.

EPISTATIC INTERACTION takes place between genes at different loci and give the dihybrid cross phenotypic ratio of 9:3:3:1 or its variation. In epistatic interactions one gene interferes or masks the effects of another at a different locus. Epistasis is different from dominance. Dominance is the masking of the expression of one gene by another at the same locus. Epistasis on the other hand is masking at a different locus. Dominance therefore is an intralocus interaction, whereas epistasis is an interlocus interaction. Putting it in another way, dominance is inter-allelic interaction or interaction between alleles of the same gene at the same locus, while epistasis is inter-genic interaction between alleles of different genes at different gene loci.

TYPES OF EPISTATIC INTERACTIONS

Six types of epistatic ratios are recognized, of which three have three phenotypes and the other three only two phenotypes.

1. RECESSIVE EPISTASIS (modifying action)

There is complete dominance of both gene pairs, but one gene when homozygous recessive is epistatic to the other.

e.g- Coat colour in mice – coat colour in rodents is determined by many gene loci, of which only two the A and the C loci, are being considered here.

i) The ancestral coat colour of the mouse is agouti, a shade of grey.

ii) A common variation of agouti is black.
iii) Another variation of agouti is albino.
When black mice (CCaa) are crossed with albinos (ccAA), the F1 progeny are all agouti (CcAa). Recombination of the C and A genes gives rise to the genotype of the wild mouse. The F1 mice are inbred, giving rise to the F2 generation. The phenotypic ratio of the F2 generation is **9 agouti: 3 black: 4 albino.** In rodents, C allele is necessary for development of colour. In CC or Cc mice the coat is coloured. The colour depends on the alleles present at another locus 'A'. The dominant A allele is required for the agouti pattern. Black mice do not contain the A allele, which comes into agouti mice from the albino parent. The A allele is epistatic to the C allele. Absence of C allele prevents development of any colour, and results in albino mice. Three of the four albinos carry the dominant A allele for agouti but lack a C allele, and thus cannot produce pigment (cc AA, cc Aa). The recessive genotype of the colour gene (cc) is epistatic to the dominant allele A of the agouti gene. Because the recessive genotype cc masks the dominant allele A, the condition is known as **recessive epistasis**.

2. DOMINANT EPISTASIS (masking action)

Dominant epistasis is also known as dominant suppressor interaction. Suppose, A is the epistatic locus and B the hypostatic locus, the gene A is dominant over its allele a, at the A locus. Similarly, the gene B is dominant over its allele b at the B locus. Since A suppresses the expression of B and b, it is recognised as the epistatic gene. Since the dominant A allele can express itself in the presence of either B or b, the epistasis is said to be **dominant epistasis**.

e.g- Coat colour in dogs- There are at least two loci involved in the inheritance of coat colour in dogs. The two loci that will be considered here are the inhibitor and the colour loci. A dominant allele B at the colour locus gives rise to black colour, while its recessive allele b expresses brown colour. At the inhibitor locus, a dominant allele I prevents the expression of both black and brown colour. Its recessive allele is i.

Dihybrid white dogs (Bb Ii) are white because of the epistatic action of the I allele over both black (B) and brown (b) pigmentation genes. The I allele suppresses the formation of pigment in the hair, resulting in a white coat. When dihybrid white dogs are mated together, the F1 offsprings are all white. Though the genotypes of the F1 individuals contain the dominant allele for black colour (B), its expression is suppressed by the inhibitor gene I. This results in a white coat. Mating of F1 individuals gives rise to the F2 generation in which the phenotypic ratio is **12 white: 3 black: 1 brown.**