POLYPHENISM IN INSECT (Termite)

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What is polyphenism ?

Polyphenism is a biological mechanism that causes a trait to be polyphenic. When polyphonic forms exist at the same time in the same panmictic population they can be compared to genetic polymrphism.With Polyphenism the switch between morphs is environmental, but with genetic polymorphism with the determination of morph is genetic. These two cases have in common that more than one morph is part of the population at any one time.

DISTRIBUTION

- order-Isoptera- Hemimetabolous (incomplete) metamorphosis , e.g- Termites

- order -Hymenoptera and undergo holometabolous (complete) metamorphosis. e.g.- bees, wasps, and ants.

- Bruchids and other phytophagous beetles (phytophaga = Cerambycidae + Chrysomelidae + Bruchidae) show Polyphenism.

POLYPHENISM IN TERMITES

1. **Worker** - foraging, tunneling, and brood tending
2. Reproductive - production of offspring
3. Soldier - colony defense

POLYPHENISM IN TERMITES

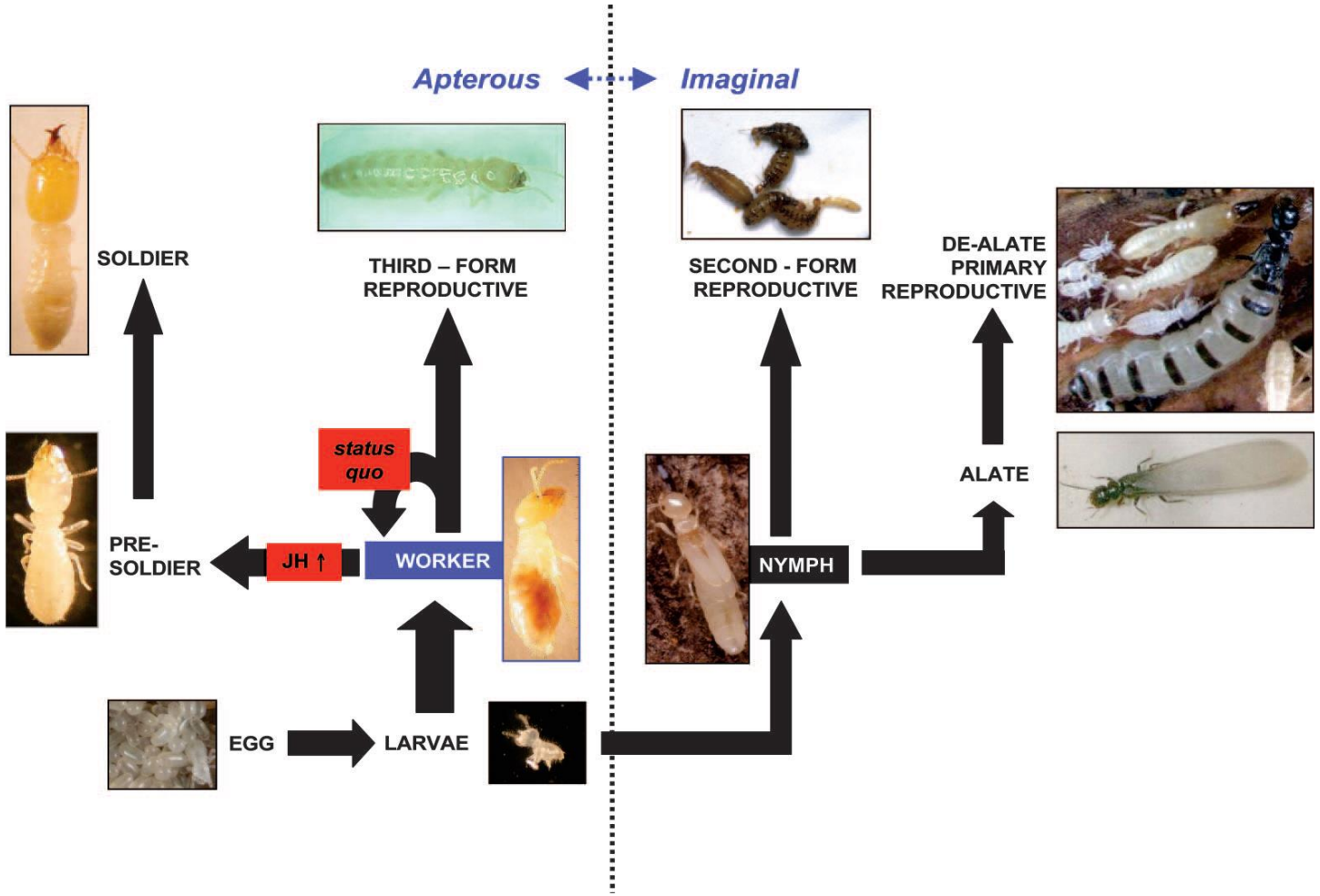

Fig - Caste differentiation and development in *Reticulitermes*

SIGNIFICANCE OF POLYPHENISM IN TERMITES

It is very important to maintain the homeostasis in the colony by distribution of the labour performed by …

1. worker
2. soldier and
3. reproductives

REGULATORY FACTORS

Extrinsic Factors

- Food quality/quantity
- Season
- Temperature
- Moisture
- Colony
- Pheromones
- Caste composition
- Auditory stimuli

Intrinsic Factors

- Nutritional status
- JH titers
- Allatostatins
- Sex
- Instar

DISCUSSION

- **JH-responsive genes and putative gene networks**

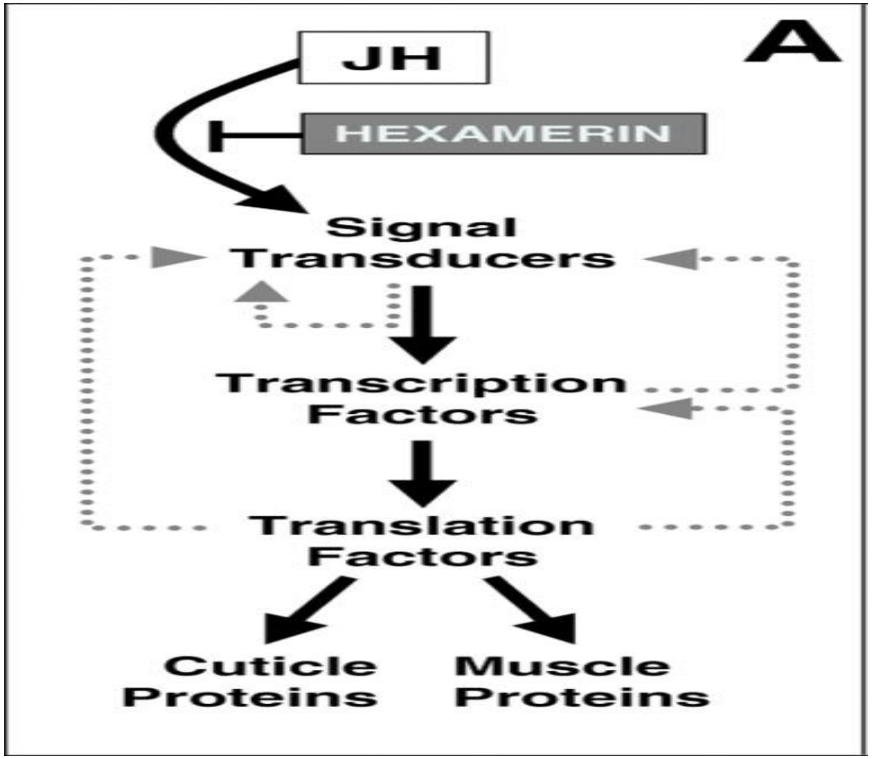

Fig. (A) depicting developmental gene networks and proposed gene relationships, as suggested by the current research.

Cont..

❑ Signal transducers

- Malonyl-CoA
- PIP kinase apoptosis inhibitor
- AMP-deaminase and ATPase- found in nymph arrays
- GTPase activity protein(GAP)- found in soldier arrays

Cont..

❑ Transcription and translation factors

- Bicaudal
- Nanos
- BTB/POZ

All play roles in the transcription and/or translation of downstream structural genes

❑ Cuticle and muscle proteins

- Cuticle proteins occur in differentiating tissues that are extremely sensitive to JH and ecdysone (e.g. imaginal disks);

- involved in processes related to chitin binding and cuticle hardening. Because of the high degree of sclerotization of the termite soldier head, and because soldier differentiation is induced by JH, it is logical to suspect that cuticle proteins would be JH-responsive.

Cont..

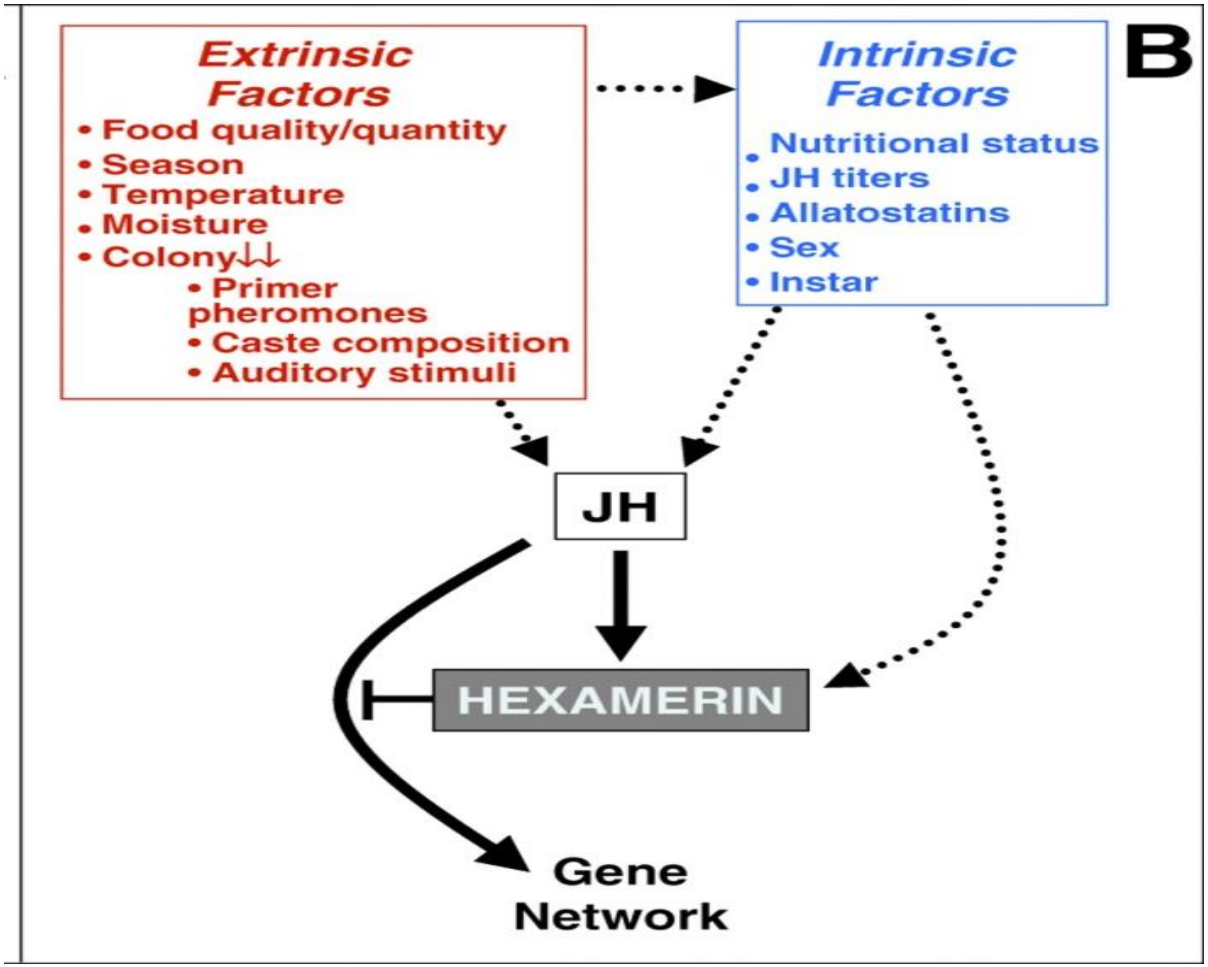

Fig. Diagrams(B) depicting developmental gene networks and proposed gene relationships

❑ Termite hexamerins and impending issues

Anti-JH blotting studies suggests that….

- hemolymph-soluble Hexamerin-1 protein is capable of covalent JH binding.
- hemolymph-soluble Hexamerin-2 protein exhibits no such JH affinity, but it does have membrane-binding characteristics much like the well-studied hexamerin receptors of higher solitary insects.
- The hexamerins modulate JH-dependent gene expression both by being JH-inducible and by sequestering JH (Fig.B). Thus, when hexamerin titers are high, JH availability (not necessarily JH titer) is presumably low and pre-soldier differentiation is attenuated.

Conclusion

- A mechanism has been proposed for the development of polyphenisms .A mutation results in a novel, heritable trait.

- The trait's frequency expands in the population, creating a population on which selection can act.

- Pre-existing (background) genetic variation in other genes results in phenotypic differences in expression of the new trait.

- These phenotypic differences undergo selection; as genotypic differences narrow, the trait becomes:

a). Genetically fixed (non-responsive to environmental conditions)

b). Polyphenic (responsive to environmental conditions

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Thank You...