

Joachim Ruther · Johannes L. M. Steidle

“Allohormones”: a new class of bioactive substances or old wine in new skins?

Accepted: 25 January 2002 / Published online: 20 February 2002
© Springer-Verlag 2002

Research on chemically mediated interactions has brought tremendous progress during the past decades. Hence, several attempts have been undertaken to update and refine the terminology of those chemicals carrying information from one organism to another (Nordlund and Lewis 1976; Dicke and Sabelis 1988). The use of a standardised terminology is especially important to facilitate communication between different scientific fields, e.g. between ecology and physiology.

However, to avoid confusion, care has to be taken that new terms are only introduced for chemicals having functions which cannot be described satisfactorily by the established terminology. Furthermore, newly introduced terms should make sense in a semantic point of view. Hence, several terms that had been proposed in the past, vanished again without being accepted by the scientific community (e.g. summarised by Duffey 1976; Nordlund 1981). Bethe (1932) proposed the term *alloiohormone* to describe chemicals that are secreted to the outside by an individual of a species to cause a specific reaction in an individual of another species. However, the term did not survive probably because it contains a contradiction in itself: A *hormone* by definition is a chemical agent produced by tissue or endocrine glands, that controls various physiological processes *within* an organism (Nordlund and Lewis 1976). Thus, a compound being a *hormone* cannot induce a reaction in another organism as indicated by the prefix “alloio”.

Almost 70 years later, Koene and Ter Maat (2001) published a paper in this journal suggesting the almost identical term *allohormone* to describe a class of bioactive substances which they define as “substances that are transferred from one individual to another free-living member of the same species and that induce a direct physiological response, bypassing sensory organs.”

Apart from the fact that the term *allohormone* still contains a contradiction in itself, we do not believe that it describes a new class of bioactive substances.

We agree with Koene and Ter Maat that the substances described as *allohormones* are different from hormones and play an important role in sexual selection. However, all examples given by Koene and Ter Maat for the claimed new class of bioactive substances undoubtedly meet the definition of *primer pheromone*, a term that has been established in chemocological research for more than 30 years. It refers to those intraspecifically active infochemicals (i.e. pheromones) that result in a complex set of physiological reactions (Wilson and Bossert 1963; Nordlund and Lewis 1976). *Releaser pheromones* on the other hand are pheromones resulting in an immediate behavioural response (Nordlund and Lewis 1976). According to Koene and Ter Maat (2001), *allohormones* are fundamentally different from *pheromones* because “...unlike *pheromones*, *allohormones* enter the body of a conspecific to act directly on target organs, bypassing external sensory structures.” To support this statement, Koene and Ter Maat cite a paper by Karlsson and Lüscher (1959) in which pheromones were defined for the first time. According to Koene and Ter Maat, this definition states that a pheromone is detected “by specialised sensory structures”. However, the original paper by Karlsson and Lüscher (1959) gave the following definition: “Pheromones are defined as substances which are secreted to the outside by an individual and received by a second individual of the same species, in which they release a specific reaction, for example, a definite behaviour or a developmental process.” Hence, the criterion that pheromones essentially have to be detected by specialised sensory structures is not part of the original pheromone definition as claimed by Koene and Ter Maat. Later updates of the definition, which have to be considered valid at present, do not even mention this aspect (Nordlund and Lewis 1976; Dicke and Sabelis 1988). They rather focus on the aspect that emitter and receiver are conspecifics, on cost/benefit aspects and on the actual origin of the chemicals

J. Ruther (✉) · J.L.M. Steidle
Freie Universität Berlin, Institut für Biologie,
Angewandte Zoologie/Ökologie der Tiere,
Haderslebener Str. 9, 12163 Berlin, Germany
E-mail: ruther@zedat.fu-berlin.de

(Nordlund and Lewis 1976; Dicke and Sabelis 1988). Thus, to our knowledge the perception by sensory organs is not part of any pheromone definition found in the literature. In fact, the most prominent textbook example of a *primer pheromone* is the queen pheromone of *Apis mellifera* honey bees (e.g., Boeckh 1995; Slessor et al. 1998), which induces considerable physiological changes in honey bee workers (Pankiw et al. 1998) and is transferred orally via trophallaxis (Howse 1998).

In conclusion, we consider the term *allohormones* to be superfluous. Chemicals referred to as *allohormones* by Koene and Ter Maat (2001) are adequately described by the established term *primer pheromone*, since they are secreted to the outside and cause a specific physiological reaction in a receiving organism of the same species.

References

- Bethe A (1932) Vernachlässigte Hormone. *Naturwissenschaften* 20:177–181
- Boeckh J (1995) Chemische Sinne. In: Gewecke M (ed) *Physiologie der Insekten*. Fischer, Stuttgart, pp 311–351
- Dicke M, Sabelis MW (1988) Infochemical terminology: based on cost-benefit analysis rather than origin of compounds. *Funct Ecol* 2:131–139
- Duffey SS (1976) Arthropod allomones: chemical effronteries and antagonists. *Proc 15th Int Congr Entomol, Washington*, pp 323–394
- Howse PE (1998) Pheromones and behaviour. In: Howse P, Stevens I, Jones O (eds) *Insect pheromones and their use in pest management*. Chapman and Hall, London, pp 1–132
- Karlsson P, Lüscher M (1959) “Pheromones” a new term for a class of biologically active substances. *Nature* 183: 155–156
- Koene JM, Ter Maat A (2001) “Allohormones”: a class of bioactive substances favoured by sexual selection. *J Comp Physiol A* 187: 323–326
- Nordlund DA (1981) Semiochemicals: a review of the terminology. In: Nordlund DA, Jones RJ, Lewis WJ (eds) *Semiochemicals. Their role in pest control* Wiley, New York, pp 13–28
- Nordlund DA, Lewis WJ (1976) Terminology of chemical-releasing stimuli in intraspecific and interspecific interactions. *J Chem Ecol* 2: 211–220
- Pankiw T, Huang ZY, Winston ML, Robinson GE (1998) Queen mandibular gland pheromone influences worker honey bee (*Apis mellifera* L.) foraging ontogeny and juvenile hormone titers. *J Insect Physiol* 44:685–692
- Slessor KN, Foster LJ, Winston ML (1998) Royal flavors: honey bee queen pheromones. In: Vander Meer RK, Breed MD, Espelie KE, Winston ML (eds) *Pheromone communication in social insects – ants, wasps, bees, and termites*. Westview Press, Boulder, Colorado, pp 331–343
- Wilson EO, Bossert WH (1963) Chemical communication among animals. *Recent Prog Horm Res* 19: 673–716