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Pheromones: Hidden Signals In Communication Behaviour

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Abstract

Pheromones are biologically active chemical signals that play a vital role in communication and behaviour among animals of the same species. Released through urine, feces, saliva, glandular secretions, reproductive fluids, and skin surfaces, these signals influence reproductive, territorial, social, and parent–young behaviours. Pheromones may function as releaser or primer signals and can convey information regarding identity, sex, reproductive status, social rank, emotional state, and territory. They are detected primarily through olfactory receptors and specialized sensory structures such as the vomeronasal organ, which transmit information to the brain and influence behavioural and physiological responses. Chemical communication is particularly advantageous because it can operate in darkness and persist across time and space, although environmental conditions may affect its effectiveness. Overall, pheromones represent a highly evolved and efficient form of animal communication with important implications for understanding behaviour, reproduction, veterinary science, and ecological management

1. Introduction

Pheromones are scents released by animals producing any kind of communication between conspecific. Karlson and Butenend (1959) proposed this term in context of sex attractant in insects. Pheromones re-leased by the male individual stimulate the sex of female. Likewise, pheromone released by the female, stimulate the sex of male. New millennium scientists have discovered sixth sense organ in human beings called Vomeronasal organ (VNO) found in the nose of higher mammals. VNO is found both in male and female and is sensitive to female and male sex pheromones. Sensory cells of VNO remains attached with olfactory bulb of brain which carry smell up to hypo-thalamus of brain. David Verliner and his associates have synthesized an artificial chemical called PDD (Pegna-4, 2 Dine-3-6-Dione). 1/100000000 part of 1 g of PDD cause sex stimulation in males. This chemical received by VNO of males

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increase the waves in brain which is the indication of being tension free. This chemical is very costly and 1mg cost about 1 lac rupees. Pheromones are released in a very small quantity but exert great influence on behaviour.

2. Discovery Of Pheromone

Bonnet was the first man who questioned why ants always move in a single line in orderly manner? To get an answer, he per-formed an ordinary experiment. He placed heap of sugar at some distance from the colony of ants. Ants move to and fro in single line between colony and heap of sugar. Bon-net rubbed his finger across the path of ants and observed that ants stopped and searched about when they reached the rubbed place, waving their antennae in the air and tapping them on the ground. There was a gradual crowding of son both sides of the rubbed point, some coming from the heap of sugar Ant new while others going towards food, until a few adventurous ants run on the rubbed place. Ants from both sides met, smelt each other and continued their journey. Bonnet assumed that it was actually a trail of chemical which ants could sense and follow

Fabre worked with the chemical message in insects. He placed a female moth in a cage near a window and observed that within 15 hours numerous males of the same species came out the woods and collected around the cage. When he placed female me moth in a tightly closed transparent glass container, where female could be seen but getting no odour, no male appeared. Fabre placed a few female moths in a container made-up of very fine wire mesh. In this case, male moths could not see females but could get essence of female. Male moths gathered around wire mesh container. Fabre concluded that emission of a chemical (pheromone) by female moth through wire mesh attracted male moths for breeding.

The horse has in fact played a central role in the development of our knowledge of mammalian pheromones. Bernhard Zondeck (1934) discovered that mare excrete oestrogen in her urine which attract stallions for mating. In the past, horse thieves used to employ a cloth soaked in urine from a mare in heat to attract stallions that they wished to steal from a meadow. Pheromones produced by a bitch in heat attract all male dogs of the area in breeding season.

3. Importance of pheromones for animal world

Pheromones evoke specific behaviour which is very significant for survival and continuation of the species. For a race, it is important that an individual should not divert energy in trial-and-error learning to achieve the appropriate goal, especially in context of reproductive activities. In many species (especially insects) the female produces a pheromone attracting the opposite sex from distance away ensure mating. Aphrodisiac pheromone facilitate copulation after the two opposite sexes have come, to together.

4. Pheromonal effects on behaviour

Chemical signals that produce rapid and specific behavioural responses are called **releaser pheromones**, whereas those that cause long-term changes in hormonal activity or development are known as **primer pheromones**. However, the same pheromonal signals can produce different effects depending on the situation. For example, certain testosterone-dependent compounds found in male mouse urine can individually accelerate puberty in young female mice (Prasad, S.,2004). When some of these compounds are combined, they can also regulate estrus cycles in adult females and even trigger aggressive behaviour in males or maternal females when an intruding male is present. Therefore, it is more appropriate to classify pheromones based on their effects (releaser or primer) rather than assigning fixed categories to specific substances.

With advances in research on chemical communication in vertebrates, additional types of chemical signals have been identified that do not strictly fit the traditional definition of pheromones. This has led to the introduction of new categories. **Signaller pheromones** convey information about an individual, such as identity, influencing behavioural decisions without causing a direct response. **Modulator pheromones** affect emotional states, for example, calming signals produced by nursing females or alarm pheromones that induce anxiety.

However, these newer classifications are less widely accepted compared to the original primer and releaser categories. An alternative approach distinguishes between pheromones that trigger innate responses and "signature odors," which provide information and depend on learning to influence behaviour.

5. Pheromonal effects on communication behaviour

5.1 Chemical Communication

Chemical communication refers to the transfer of information through biologically active substances known as semiochemicals. When these chemicals act between members of the same species, they are often termed pheromones. Animals release such substances through urine, feces, saliva, sweat, glandular secretions, reproductive fluids, or skin surfaces. These chemicals are detected through olfactory receptors or specialized sensory organs, which then trigger specific responses in the receiver. This system allows animals to exchange messages without direct physical contact or visibility.

5.2 Evolutionary Importance

Chemical signalling is believed to be one of the earliest forms of communication to evolve because all living organisms naturally produce chemical compounds. Even simple

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organisms respond to chemical gradients in their environment. As animal life became more complex, these chemical cues developed into advanced systems for mating, defence, territorial behaviour, and group coordination. Many modern animals still depend heavily on this ancient communication method, especially species that are nocturnal, burrowing, aquatic, or inhabit dense forests where visual communication is less reliable.

5.3 Information Conveyed Through Chemical Signals

One of the most remarkable features of chemical communication is the amount of information that can be carried in a scent. Chemical signals may reveal the species identity, sex, age, reproductive status, health condition, social rank, emotional state, territorial ownership, and even genetic compatibility of an individual. In many mammals, body odour provides cues about immune status and disease resistance, which can influence mate selection. Individual animals often possess unique scent profiles that enable recognition by family members or social partners. Thus, chemical communication is not merely a simple odour system but a highly complex source of biological information.

5.4 Role in Reproductive Behaviour

Reproductive behaviour is strongly influenced by chemical communication. Many female insects release airborne attractants that guide males from considerable distances. In mammals, males often identify females in estrus through urinary or vaginal odours. These chemical cues stimulate courtship behaviour, sexual interest, and successful mating. In some rodents, exposure to opposite-sex odours can accelerate puberty or influence hormonal secretion. Chemical signals therefore help ensure that mating occurs at the most suitable time, improving reproductive success and continuation of the species.

5.5 Role in Territorial and Social Behaviour

Territorial animals frequently use chemical signals to mark their surroundings. Dogs, wolves, cats, and many other mammals deposit urine or glandular secretions that communicate ownership of an area. Other animals receiving these signals can assess whether the territory is occupied, the likely strength of the owner, and how recently the mark was placed. This reduces the need for direct physical conflict and conserves energy. In social species such as ants, bees, and termites, chemical communication is essential for maintaining colony life. Colony odours help identify nestmates, while queen-produced chemicals may regulate reproduction and worker behaviour.

5.6 Parent–Young Recognition

Chemical communication is equally important in parent-offspring relationships. Many mothers recognize their young by scent shortly after birth, while newborn animals learn to

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identify the odour of their mother for feeding and protection. (Bell, W. J., 2004). This is particularly important in herd animals such as sheep, goats, and cattle, where mothers must distinguish their own offspring among many others. Successful recognition strengthens bonding and improves survival of the young.

5.7 Mechanism of Detection

The reception of chemical signals depends on highly sensitive olfactory systems. In vertebrates, receptors in the nasal cavity and the vomeronasal organ detect specific molecules and send nerve impulses to the brain. These impulses may trigger immediate behaviour, hormonal responses, or memory formation. Some animals can detect extremely small concentrations of chemicals, allowing them to respond to signals from great distances or long after deposition. This extraordinary sensitivity explains the effectiveness of chemical communication in many species.

5.8 Advantages and Limitations

Chemical communication offers several advantages over other forms of signalling. It is effective in darkness, dense vegetation, underground tunnels, and water. It can persist for hours or days, allowing communication across time as well as space. It also requires relatively low energy compared with repeated vocalization or elaborate visual displays. However, chemical communication may be slower than sound, and environmental factors such as wind, rain, or water currents can alter signal strength. Predators may also exploit these signals to locate prey. For this reason, many animals combine chemical communication with sound or body language.

5.9 Evaluation of Chemical Communication

From a behavioural perspective, chemical communication is one of the most efficient systems used by animals. Its greatest strength lies in providing long-lasting information about identity, reproductive status, and territory without requiring the sender's presence. This makes it highly suitable for solitary and territorial species. However, it is less effective for rapid, immediate interactions where sound or movement is faster. Despite this limitation, the widespread presence of chemical signalling across species demonstrates its major evolutionary success. It remains one of the most reliable and versatile methods of animal communication.

6. Conclusion

Pheromones play a crucial role in shaping animal behaviour, but their effects are highly species-specific and may not be present even in closely related species. Chemical communication is a silent but highly powerful language of animals. Through invisible molecules, animals exchange information about identity, territory, reproduction, danger, and social relationships. Though often unnoticed by humans, it governs many critical aspects of animal behaviour. Its persistence, versatility, and biological richness make it one of nature's most successful communication systems. Continued study of chemical signals will deepen our understanding of animal behaviour and provide valuable tools for veterinary and ecological management.

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