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CHEMICAL COMMUNICATION

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ABSTRACT

Chemical communication is a universal feature of life that occurs at all levels of biological organization. It may be regarded as an integral part of the biological signaling field. Chemical communication in humans has largely been ignored. Animals communicate with visual, sound, touch, and chemical signals. This paper provides a brief introduction to chemical communication.

KEYWORDS: Chemical communication, chemical signals, animal communication.

INTRODUCTION

Communication is the process of establishing a connection between two points. Human beings communicate through sound, sight, voice, looks, and body. For the majority of creatures, chemical communication between the creatures and the surrounding environment is the most important way of communication.[1] Chemical communication is important in many scientific fields, such as in biology, physics and chemistry, where systems are capable of giving and receiving information. It is the most ancient and widespread form of information transfer among organisms. It involves complex interconnected networks that serve to fine-tune the expression of diverse group behaviors. The message is transferred via chemicals placed into the environment.

The communication is usually between animals of a same species, but it can also happen between two animals of different species. Chemical communication overcomes barriers and extends to locations that light waves cannot reach. It helps animals find mates, establish dominance, defend territory, assemble or care for the young. Animals communicate using a

wide range of stimuli or signals. Communication enables animals to perceive what conspecifics are aware of and reach accordingly.[2]

Types of Communication

There are four methods of communication: auditory (sound), visual (sight), tactile (touch), and chemical (smell and taste). Auditory communication (based on sound) is often used in the animal kingdom, especially among birds. Visual communication (based on sight) involves signals which include gestures, facial expressions, and body postures. Tactile communication requires actual contact between animals. The most widely used method of communication is the invisible language of odors. These silent messages consist of chemical signals called pheromones. Taste and smell are used to interpret these chemical messages.

Pheromone and Chemical Communication

The term "pheromone" is used to describe chemical messages that pass between animals of the same species. Pheromones play an important role in the behavior of a wide variety of organisms, from bacteria to elephants, but no human pheromones have been chemically identified to date.[3] Pheromones consist of combinations of chemicals found on the face, head, chest, arms, legs, back, rump, or in other such locations. Some animals such as coyotes, wolves, and dog use urine to identify their territories. Urine is also used by many animals to transmit sex attractants. Young fish use scent to identify members of the same species.[4,5] Dogs communicate using pheromones. By urinating on a bush or post, a dog leaves a mark of their identity.

Chemical signals play an important role in the behavior of most organisms. They are involved in schooling, territorial marking, species, individual recognition, courtship, readiness for mating, and in parent–young interactions. Signals advertising sex, receptivity, and specific phases in mating behavior are common. Chemical signals are always present in sexual communication in most living organisms.

The term "chemical communication" was introduced by the Russian researcher V.E. Sokolov in the 1970s.[6] Chemical communication provides an energetically efficient and long-lasting signal. It refers to the use of signals from saliva, urine, faeces, vaginal secretions, semen or secretions from the skin. Sources of odors used in chemical communication between animals include urine, faeces, saliva or secretions.

Applications

Applications of chemical communication principles may include nanodevices, food webs, and molecular logic gates.

- *Nanodevices*: Traditional communication technologies cannot be applied on the nanoscale since transmitters and receivers are still too big to fit on a nanoparticle. A potential approach to establish communication at the nanometric level is to mimic how nature communicates such as molecular communication, chemical communication or chemical communication through molecules.[7] Nanodevices can communicate through chemical messengers.
- *Food webs*: Food webs are maps of ecosystem matter and energy flows. They define interactions between organisms. There are numerous studies that describe communications that facilitate food web interactions.[8]
- *Molecular logic gates*: This involves the use of logic principles in devices for multi-analyte and multiplexed sensing, intelligent materials, and molecular computing. Chemical (or photophysical) communication can be used to concatenate molecular logic gates.[9]

Other applications span all-optical integrated logic operations to applications in the rhizosphere.

Challenges

Chemical communication faces several challenges. First, a major challenge of chemical communication is to better understand the kinds of information chemical signals provide. Our incomplete understanding of basic biochemical processes limits what can be built. A second challenge is to unravel the proximate mechanisms that control chemical communication. Third, there are major unsolved questions regarding the evolution of chemical communication. A fourth major challenge is to better understand the role of chemical communication in the behavior of our own species. The final major challenge is to determine how chemical pollutants in our environment disrupt biological chemical signaling systems.[9]

CONCLUSION

All organisms communicate, most by way of diffusion of chemical signals. Communication allows living systems and various devices to transfer information. Chemical communication is ubiquitous and conveys information between organisms. As research in chemical communication advances, it becomes clear that chemical signals span all domains of life.

More information about chemical communication can be found in the following three journals exclusively devoted to it: Chemical Communications, Bulgarian Chemical Communications, and Inorganic Chemistry Communications.

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