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Dhrubajyoti Borpujari

Department of Animal
Reproduction, Gynaecology and
Obstetrics, College of Veterinary
Science, Assam Agricultural
University, Khanapara,
Guwahati, Assam, India

Mohua Dasgupta

Department of Animal
Reproduction, Gynaecology,
Obstetrics, College of Veterinary
Science, Assam Agricultural
University, Khanapara,
Guwahati, Assam, India

Himsikha Chakravarty

Department of Animal
Reproduction, Gynaecology,
Obstetrics, College of Veterinary
Science, Assam Agricultural
University, Khanapara,
Guwahati, Assam, India

Pheromones of pig: An overview

Dhrubajyoti Borpujari, Mohua Dasgupta and Himsikha Chakravarty

Abstract

Air-borne chemical substances (“signals”) released in the urine or faeces of animals or secreted from cutaneous glands that are recognised by the olfactory system and that elicit both behavioural and endocrine responses in conspecifics are known as Pheromones. Different biological agents or hormones have been used for regulation of animal reproduction for improvement of production, but due to non-availability or low cost effectiveness of such agents and to harness the reproductive potential of various livestock, pheromones have a great role on bio stimulation. Pigs have many pheromones such as sexual pheromones, stress related pheromone, maternal and neonatal pheromone, aggressive and submissive pheromones etc. These pheromones were found to induce early puberty, influence reproductive processes such as sperm transport and ovulation processes, increase levels of pituitary FSH during lactation and render a calming effect on piglets. Various pheromones responsible for reproductive and behavioural stances in swine are androstenone, androstenol, quinoline, skatole and myristic acid which are secreted in their saliva, faeces and urine. Although an extensive study have been conducted on boar very less has been known about sow pheromone providing a wide zone for study in this area. This review attempts to update facts relating to pig pheromones.

Keywords: pheromone, biostimulation, androstenone, androstenol, quinoline, skatole and myristic acid

Introduction

Pheromonal communication plays an important role in mammalian behaviour and reproductive processes. In mammals, signalling and priming pheromones may act either singly or in combination through olfaction, audiovisual or tactile stimuli. Air-borne chemical substances (“signals”) released in the urine or faeces of animals or secreted from cutaneous glands that are recognised by the olfactory system and that elicit both behavioural and endocrine responses in conspecifics are known as Pheromone [1, 2]. Reproductive responses to social cues have been documented for most farm and domestic animals, laboratory rodents and primates [3]. Different biological agents or hormones have been used for regulation of bovine reproduction for improvement of production, but due to unavailability or low cost effectiveness of such agents and to harness the reproductive potential of various livestock, pheromones have great role on biostimulation [4]. There are some other terms related to pheromones such as semiochemicals, interomones etc. Semiochemical is the generic term for chemical signal (s) that bear a sense (could be within or between species). It includes include allomones, pheromones, kairomones, interomones, repellants, attractants, individual odor signatures, gender signatures and more. Interomone is defined as a semiochemical that acts as pheromone of one species but elicits physiological responses in a different species where the pheromone molecules have not yet been identified [2]. Pigs have more olfactory receptors compared to most of the mammals. There are almost 1,113 olfactory receptors in pig. They have a very keen sense of smell. They can detect odours many folds lower in concentration than humans. In boars, saliva is the major source of pheromones. These pheromones were successful in eliciting mating stance behavior in sows. For improved reproductive success in pigs knowledge of both sow and boar pheromones is needed. There was extensive study on boar compared to sow [5].

Pheromones and their effect: Pigs have many pheromones such as sexual pheromones, stress related pheromone, maternal and neonatal pheromone, aggressive and submissive pheromones etc [5]. In domestic pig, puberty in females has been shown to be accelerated by the presence of the male. Gilts reared in confinement that were exposed to a boar reached puberty at an earlier age [6]. Reduction in postpartum period and age at onset of puberty was seen in sow exposed to boar. Daily exposure of a mature boar to prepubertal gilts from an age of approximately 160 days onwards resulted in advancement of puberty [7].

Corresponding Author:

Dhrubajyoti Borpujari

Department of Animal
Reproduction, Gynaecology and
Obstetrics, College of Veterinary
Science, Assam Agricultural
University, Khanapara,
Guwahati, Assam, India

The sensory cues involved in the boar's effect on puberty were olfactory cues and that exposing the gilts to a pen which was previously occupied by a boar and presumably permeated with his odor induced early puberty^[8]. It was found that the priming pheromones remaining in the boar's pen after its removal were sufficient to induce early puberty and such gilts are found to have good reproductive performance compared to normal unexposed gilts. Generally, sows were in lactational anestrus which was due to negative effect of suckling on LH release. This condition was overcome by the exposure of a boar^[9]. It is known that specific boar stimuli at or around the moment of insemination can influence reproductive processes such as sperm transport and ovulation processes and consequently affect reproductive performance^[8]. This is an essential management practice in systems of production that rely on rebreeding at lactational oestrus for efficient operation. It was also found that the exposure of boar increases levels of pituitary FSH in lactation and these higher FSH at weaning evoked a more rapid onset of oestrus and ovulation^[10].

There was very less study on sow pheromone. Faeces, urine, saliva are some of the potential sources of pheromone in sow. there was report of salivation in boar on exposure to an estrous sow or exposure of faeces or urine from an estrous sow or gilt^[11]. Piglets have a special affinity for maternal faeces in early life. It was reported that exposure to volatile substances extracted from sow faeces and urine or other cutaneous secretion from the sow's body had a calming effect on piglets and increase in feeding intact and growth rate^[12].

Various pheromones responsible for reproductive and behavioural stances in swine

- a. Androstenone: Boars saliva is the major source of this pheromone. It is responsible for mating stance behaviour in sow. Chemical formula is 5α -androst-16-ene-3one^[5]. It is a steroid produced in the testes as the boar nears puberty and is released into the blood stream. In the salivary gland this steroid is removed by the action of specific binding protein and released into the saliva. This salivary androstenone induce a mating stance in estrous sows and also enhance puberty in gilts. It is hydrophobic in nature and also accumulates in the adipose tissue resulting in an off-odour when heated. Androstenone is metabolised in liver through both Phase I (hydroxylation) and Phase II (conjugation) reactions.
- b. Androstenol: It is generally found in boar saliva and adipose tissue. The chemical formula is 5α -androst-16-en-3-ol. It is also responsible for mating stance in sow. it alone unable to elicit sexual response in sow. Together with other pheromone it elicited sexual response in sow^[13].
- c. Quinoline: It is a newly identified pheromone, a heterocyclic aromatic hydrocarbon molecule in boar saliva which together with other two pheromone i.e., Androstenone and androstanol elicited sexual behaviour in sows^[13].
- d. Skatole (3-methylindole): It is produced by bacterial degradation of tryptophan in the hindgut. The intermediate product in the production of skatole from tryptophan is 3-indole-acetic acid. It is metabolised in the liver and excreted in urine and partially deposited in the fatty tissue. It is found in the gut of both male and female pig in equal amount but due to its poor metabolization by some males it is accumulated in the body fat^[14]. It is a

faecal semio chemical which is having a positive effect on piglets.

- e. Myristic acid (1-tetradecanoic acid): It is a fecal semio chemical. The source of this pheromone is sow faeces. Together with skatole it has a positive effect on growth of weaned piglets. Piglets have an affinity towards mother faeces. It is due to presence of pheromone. It was found that exposure to sow faeces to weaned piglets gives a calming effect and anti-aggressive behaviour among piglets. There was increase in feed intake among piglets thus increase in growth rates.

Conclusion

Both boar and sow secrete different pheromones (androstenone, androstenol, quinoline, skatole and myristic acid) in their body fluids through which they establish chemical relationship among each other. Different sources of pheromones found till date are saliva, faeces, urine etc. Sexual pheromones are considered as clean, green and ethical technologies to improve reproductive success. Therefore it is evident that there is ample scope to conduct studies on pheromones and their effects.

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