

# Why anti-inflammatories are important in the swine industry

Anti-inflammatories are among the drugs most used in livestock species and they are normally used as adjuvants in the treatment of infectious diseases (for example pneumonia), as antipyretics or to treat localised inflammatory processes (such as arthritis).

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The main function of anti-inflammatory drugs is to counteract the various effects caused by the activation of the inflammatory response. But, before understanding the mechanism of action of anti-inflammatories, it is important to know how the inflammatory response develops and what elements are involved in it.

## Inflammation, pain and its consequences

The term pain is defined as 'an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage'. This definition was deliberately formulated to include non-human animals, by the specification of 'the inability to communicate verbally does not negate the possibility that an individual is experiencing pain and is in need of appropriate pain-relieving treatment'.

There are several suggested ways to categorise pain, typically based on the involvement of inflammation as well as the anatomical location of the tissue damage. This distinction can be recognised across animal species, and is central for the understanding of the welfare consequences of animal pain:

- **Noiceptive pain:** short-lasting pain arising from actual or threatened damage to tissue. Arises from activation of nociceptors. Its biological function is to protect the organism from injury.
- **Inflammatory pain:** more persistent pain arising from

inflammatory processes at a site of tissue damage. May lead to hyperalgesia. To protect the healing tissue.

- **Chronic pain:** a pain state which persists even after healing of the initial tissue damage or where no healing is possible. May be inflammatory or not. Non-adaptive.

Pain is a percept consisting of initial nociception followed by a slower but integrated emotional phase and its responses occur only after centralised processing, and elicitation of an emotional output to the nociceptive input.

For example, acute centrally processed pain can be recognised in animals by behavioural changes that include, among others, loss of mobility, vocalisation, tachypnea, loss of socialisation, and inappetence.

## Animal welfare: the importance of pain management

Current attitudes about animal welfare have increased the importance of pain management in livestock. Even minor surgical procedures in livestock are now performed using a combination of regional, local, or general anaesthesia combined with uninterrupted post-surgical analgesia. Procedures that require pain control include tail docking, castrations and/or ear tattooing/tagging. And, on the other hand, there are situations such as prolapses, fractures or bites where animals suffer and we need to control the pain and eliminate it.

## How to control and avoid pain in pig farms?

Classes of anti-nociceptive drugs that can be administered to food animals include:

- **Local analgesics:** This type of drug, such as lidocaine, is very effective in reducing nociception signs during castration.
- **Steroidal anti-inflammatory drugs (SAID):** Indicated for the treatment of muscular and joint inflammatory



processes, meningitis, etc. Dexamethasone is one of the most used in pigs within this category.

- **Non-steroidal anti-inflammatory drugs (NSAID):** These are widely used in production animal practice to relieve the negative effects associated with the inflammatory cascade such as excessive swelling, fever or pain. The aim of using NSAIDs is to improve the welfare of the animals and recover their performance, that is often impaired by chronic pain, inflammation and fever.

But it is not as simple as it seems because anaesthetics, such as opioids or local anaesthetics, must be exclusively administered by the veterinarian.

The alternative is anti-inflammatory drugs since, although they require a prescription and veterinary supervision, they can be included in the management protocols for the aforementioned situations and administered by the farmer.

## NSAIDs effects on the inflammation process

NSAIDs main mechanism of action is the inhibition of cyclooxygenase (COX), which mainly implies a block on the synthesis of prostaglandins (PG).

Among the mediators of inflammation, PG are especially relevant and numerous studies have indicated two important roles for

pro-inflammatory PGs in inflammation:

- Dilate the arterioles, increasing blood flow to the area of injury. Vasodilation and increased vascular permeability cause redness, increased temperature, and swelling.
- Notably activate the nociceptive stimulus produced by other mediators, a phenomenon called hyperalgesia. Mediators including inflammatory cells migrate into tissue releasing inflammatory mediators that cause pain.

The analgesic and anti-oedematous actions of NSAIDs are mainly due to the inhibition of these mechanisms, although they exert many other effects at the molecular level.

Majority of the NSAIDs that are currently used elicit their potent anti-inflammatory, antipyretic, and analgesic effects through differential inhibition of COX isoforms (COX-1 and COX-2) and to a lesser extent lipoxygenase (LOX).

Moreover, there are some pharmacokinetic considerations to take into account:

- As weak acids, NSAIDs are usually readily absorbed following oral administration.
- Injectable solutions tend to be alkaline and can cause pain and necrosis in cases of extravasation.
- Drug elimination rates of NSAIDs are variable, depending on drugs and species. Most NSAIDs are eliminated primarily via hepatic phases I and II metabolisms. Conjugate metabolites

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are then excreted in the urine/  
faeces. However, a small amount  
may be excreted in their unchanged  
form in the urine/faeces as well.

### Types of NSAIDs and how to use in pig farms

Among the non-selective COX inhibitors, there are two main groups of NSAIDs:

- **Enolic acids:** This includes oxicams (meloxicam) and pyrazolones (phenylbutazone).
- **Carboxylic acids:** This includes nicotinic acid (flunixin meglumine), fenamates (meclofenamic acid), salicylates (aspirin), propionates (ibuprofen, naproxen, ketoprofen, carprofen) and acetic acid (etodolac).

In general, it has been proven that NSAIDs administered to sows help them recover from a painful situation such as lameness or post-partum dysgalactia syndrome.

NSAIDs also decrease the mortality rate at weaning in litters from healthy sows and in sows with dysgalactia syndrome. However, studies on the effect of NSAIDs on sow welfare, piglet growth and immunity transfer in healthy sows show discrepancies. Piglets are surgically castrated on commercial pig production farms to prevent

boar taint and reduce aggression. This is known to be a painful procedure, based on specific behavioural and physiological indicators, including rump scratching, increased blood cortisol levels, and high-frequency vocalisations, yet piglets are generally not provided any anaesthesia for pain relief.

NSAIDs such as meloxicam and ketoprofen are the most common type of analgesic given to food animals and are currently being recommended for use in piglets to alleviate pain.

### Meloxicam

Meloxicam is an NSAID that acts inhibiting:

- Cyclooxygenase-2 (COX-2): this inhibition allows a good anti-inflammatory, antipyretic and analgesic effect.
- Cyclooxygenase-1 (COX-1): only with residual effect but it helps to reduce NSAIDs adverse effects in the gastrointestinal tract because COX-1 isoform promotes the production of prostaglandins with a protective function in gastric mucosa, kidney, platelets and immunity cells.

In the swine industry, meloxicam is basically used in:

- Non-infectious locomotor disorders to reduce the symptoms of



lameness and inflammation.

- The treatment of puerperal septicaemia and toxemia (mastitis-metritis-agalactia (MMA) syndrome) like an adjunctive therapy with the appropriate antibiotic.

### Flunixin meglumine

This NSAID inhibits cyclooxygenase in a reversible and non-selective way and it has less side effects than corticosteroids. On pig farms, flunixin meglumine is used in:

- Respiratory diseases mainly in fattening pigs, where this NSAID reduces fever improving the recovery of affected pigs.

- Lameness and/or arthritis even in piglets or sows.
- Acute inflammation.
- MMA syndrome.

### Ketoprofen

Ketoprofen is used like an anti-inflammatory and antipyretic treatment of postpartum dysgalactia syndrome (PDS) and for the reduction of pyrexia and dyspnoea associated with respiratory disease in combination with appropriate anti-infective therapy. ■

References are available from the author on request