Practical tips for successful treatment of pigs via drinking water

Veterinary medicines for pigs can be administered in different ways. The choice of the administration route depends on specific factors in the field and the clinical health status of the pigs.

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Parenteral application in pigs is most commonly implemented for a quick acting cure of individual or smaller groups of animals. Injections are labour intensive and stressful for the animals, but unaffected by water and feed intake. The oral administration via feed or drinking water is more indicated for curative or metaphylactic treatments in larger groups of animals.

Both feed and water medication have advantages and disadvantages. In-feed medication is a reliable way of the administration of medication which is less susceptible to human errors and ensures that treatment is provided for the required treatment period.

Water medication, on the other hand, is a more flexible administration route. It is the most convenient way for different dose regimes (pulse, continuous) and reaches faster sufficient tissue concentrations when started with a loading dose. As well as individual pens, larger groups can be targeted once the drinking water system is installed. Water medication offers the distinct advantages of minimising labour requirements and providing a stress-free and animal friendly therapy, which can be started immediately after the veterinarian's diagnosis. A prompt treatment in the early stage of a disease outbreak results in a rapid response to the therapy. Depending on the clinical results, the treatment can easily be adjusted.

These are the main reasons why veterinarians turn to water medication more and more. However, there are some rules to take into account to ensure a successful treatment via the drinking water.

The antimicrobial should reach the infection site in all the treated animals sufficiently. Different factors play an important role in the interval between the mixing of the product in the drinking water and the active molecule reaching the animal's gut and the infected tissue.

Along with the choice of a water soluble product showing high solubility and stability and its correct application, the drinking water quality and the medicated water delivery system are of major importance to guarantee maximal efficacy.

10 golden rules for successful water medication

- Follow veterinary instructions for the practical use.
- Administer the correct daily dose based upon bodyweight.
- Choose a product with good solubility and stability.
- Calibrate proportioners regularly.
- Dose time-dependent antimicrobials continuously and concentration-dependent ones as a pulse.
- Ensure that the bulk tank is clean, covered and free from debris or contamination.
- Treat pigs preferably in the afternoon.
- Clean the water delivery system after each treatment.
- Consider the use of tap water for drinking water medication.
- Never use disinfectants concurrently with medication.

Water quality

The properties of medication administered via the drinking water can be changed by the water quality. Several physico-chemical parameters of the drinking water such as the pH, hardness and the temperature have an enormous impact on the solubility and stability. These parameters consequently influence the efficacy of a treatment. Some molecules, such as doxycycline and amoxicillin, require a specific pH optimum to reach maximal solubility and stability. Less absorbable complexes can be formed when antimicrobials belonging to the tetracycline group are dissolved in water with an increased concentration of bivalent cations (calcium, magnesium, iron). Metal ions reduce the stability of amoxicillin in water.

Formulation is crucial to ensure that the active molecule reaches the targeted tissue sufficiently in water of different qualities and without loss of palatability.

Microbiological contamination of the drinking water can not only enhance diseases but can also influence the palatability and break down antimicrobial activity – for example, amoxicillin deteriorates as a result of its sensitivity to beta-lactamases produced by some bacteria present in the drinking water.

Regular cleaning and disinfection of the pipelines and storage tanks is a good strategy to prevent residues and bacterial contamination. Water delivery systems should be cleaned after each addition of medication.

Disinfectants (chlorine, hydrogen peroxide) and pH modifying products (acidifiers) can interfere with the stability of the medication in the water, justifying a temporary cessation of those products when antimicrobial treatment is started.

High quality drinking water is a key input for profitable pig production and should always be clear and odourless to ensure good palatability. Therefore, the water quality must be carefully assessed prior to administration of medication and a yearly standard monitoring protocol is advised. In case of abnormalities the necessary adaptations should be carried out.

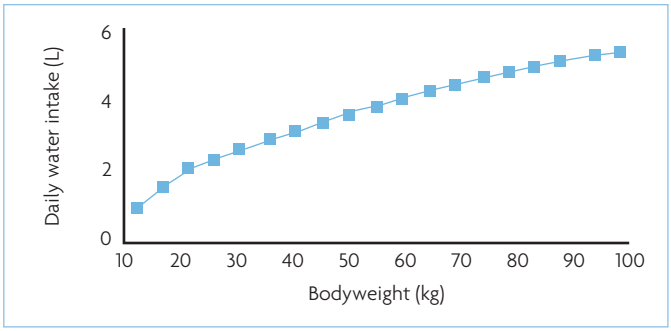

Fig. 1. Daily water consumption (litre) of fattening pigs at a moderate environmental temperature.

Uptake of water

The clinical health status of the pigs, time of the day and local conditions such as ambient temperature and air humidity play a crucial role in the daily uptake of water.

In case of illness, the daily water uptake is generally less affected than feed consumption. However, sometimes the clinical health status can be so bad that individual parenteral treatment is required. Peak level of water consumption is noticed in the afternoon.

To be sure that all animals take up sufficient product, this period of the day is ideal to medicate. On the

Table 1 . Daily water consumption of sows and boars at a moderate environmental temperature.

Sows	Litres
Not in gestation	8-12
Early gestation	8-12
Late gestation	10-15
Lactation	15 + 1.5/piglet
Boars	
Boars	10-15

other hand, to avoid wastage of medicated water in hot periods, the administration of medication during the cooler moments of the day might be a logical alternative.

Water delivery systems should be checked regularly for their functionality to guarantee the delivery of the required volume of water. A closer look at the waterflow through the different pipelines can reveal some critical control points. For correct dosing of the pigs, the waterflow should be equal through all the pipelines. As well the number and the height of the drinkers, the water pressure must be taken into consideration. One drinker is recommended per 10-15 pigs.

The height of the drinkers should be at about snout level of the smallest pig in the pen. Inconsistent water pressure and clogged lines can lead to a variation in flow rate, hence affecting uniform uptake of water medication by pigs. This underlines the great importance of the solubility of in-water administered veterinary products.

The daily water uptake in pigs up to 35kg is approximately 10% of their bodyweight, whilst it is normally 7% for heavier pigs. The standard daily water consumption at a moderate environmental temperature for fattening pigs and sows is illustrated in Fig. 1 and Table 1.

Product choice

The first step in each antimicrobial treatment is the choice of an appropriate molecule. Due to variability in sensitivity of bacterial pathogens, sampling and antibiotic susceptibility testing are recommended and should be interpreted with care by a veterinarian. The choice of the formulation is the second, but no less important, step. Once applied in the drinking water, solubility, stability and bio-availability must be guaranteed.

Huvepharma has always focused on quality formulations and considers this as the keystone for its products. A typical example is Pharmasin 100% water soluble granules (tylosin tartrate) which demonstrates excellent solubility and stability in water of different qualities and ensures total absence of sedimentation. Sedimentation automatically results in subtherapeutic dosing, with lack of efficacy as a result.

In-water use of medication is based upon the appropriate dissolution of water soluble powders or oral solutions. A complete homogenous dissolution guarantees the highest bio-availability in the animals without any loss of product, product sticking in the waterlines or risk of blockage for the nipples.

The release of the active compound is determined by the speed and rate of the dissolution (Fig. 2).

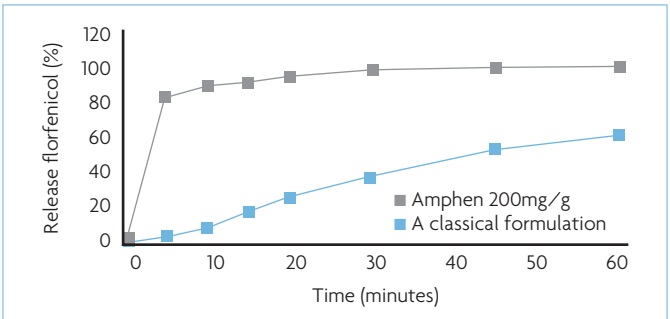

Fig. 2. Importance of formulation: dissolution profile of 5g Amphen 200mg/g per litre versus a classical florfenicol formulation at same concentration in hard water of 20°C.

Medication fully dissolved prior to use will finally lead to the best therapeutic results in the field. Intestinal absorption of orally administered antimicrobials is highly variable due to differences in enterocyte permeability (=intestinal barrier). Florfenicol (Amphen 200mg/g oral granules) for example, has a very high lipophilic character, easily passing this barrier.

This results, not only in a readily and almost complete absorption, but also in fast and significant serum concentrations and a good tissue distribution. In contrast, aminoglycosides such as apramycin (Apravet 100g/kg premix) and paromomycin (Parofor 70mg/g powder) are hydrophilic and therefore poorly absorbed.

The oral administration of the latter molecules is perfect for the control or treatment of enteric pathogens, but not for pathogens located outside the intestine. The degree of liposolubility can also largely vary within a family of antimicrobials. Doxycycline for example, is much more lipophilic than tetracycline.

Some products should preferably not be combined in drinking water systems as this might lead to precipitation, antagonism or toxicity. Your veterinarian can give you tailor-made advice.

Finally, the product choice is also determined by its palatability. Administration of, for example, Pharmasin 100% water soluble granules (tylosin tartrate) or Amphen 200mg/g oral granules (florfenicol) via the drinking water does not interfere at all with the daily water intake, if correctly administered.

Administration route

Bulk tank systems (1000 litres) are simple and effective. An adjustable float valve can be installed to limit tank capacity to the required volume but will consequently also continuously dilute the medicated water.

The use of a clean bucket is advised to prepare a pre-dilution separately. As part of good veterinary practice, stirring with a kitchen whisk might be required to ensure perfect dissolution once the medication has been added to the water in the bucket. After this preparation, cut the normal water supply off, pour the pre-dilution into the bulk tank and stir. The bulk tank should preferably be a closed system to avoid contamination.

Proportioner medication systems rely on a mechanical or electronic pump to deliver measured amounts of a stock solution of a dissolved product into the water line. A higher pump quality guarantees a longer lasting functionality without losing proportioning accuracy.

More advanced devices provide very accurate dosing by continuous monitoring of the waterflow.

Proportioners are mobile and less spacious, hence more convenient for larger and more complex facilities. One proportioner can be moved from pen to pen on a hand cart and plugged to different water lines using quick-release fittings.

The calculated dose of the product is added to a volume of fresh water in a clean bucket or small container and the stock solution should be stirred with a kitchen whisk until a homogenous mixture is reached. Do not use a mixing cane. After determination of the dilution percentage, the external filter with a tube can be inserted. The leaning position of the container guarantees the most complete emptying.

Proportioner.

Medicators should be inspected for maximal efficiency and the external filter rinsed, if necessary. Farmers and veterinarians prefer to have visual control of the medication applied in the drinking water and this is one of the reasons for the increasing tendency to use proportioners in the field. Therefore, the art of product formulation is the key to success.

Hygiene of both stock solution containers and bulk tanks is crucial to avoid possible interactions with the administered medication and partial or complete blockage of the filters of the drinking water distribu-

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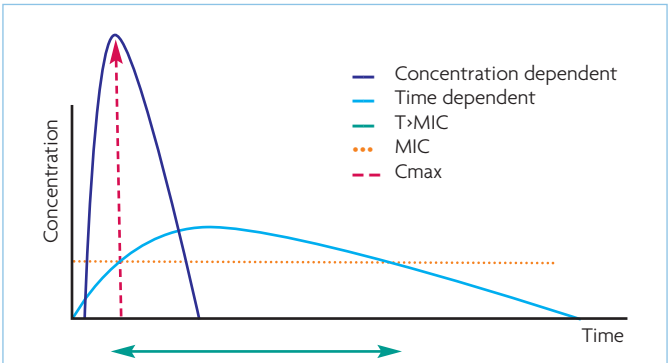
Fig. 3. Two types of antimicrobials with an ideal pharmacokinetical profile with regards to efficacy.



Cmax: maximum concentration, MIC: Minimum inhibitory concentration
T>MIC: Time concentration is above MIC.

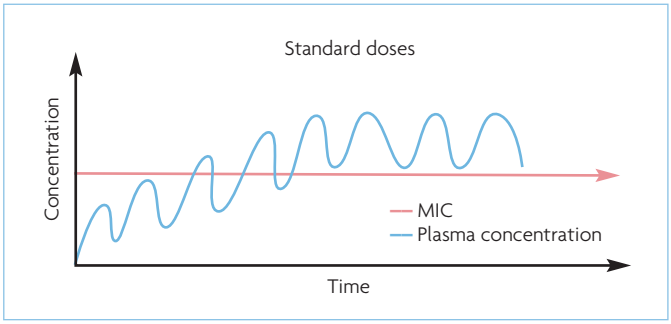


Fig. 4a. Standard dose.

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tion system. A water capacity for a treatment for 12 to 24 hours is desirable. Medicated water should be replaced every 24 hours unless otherwise recommended on the specifications.

Finally, water soluble products can also be added in cups filled with drinking water for piglets in the farrowing units, mainly to deal with enteric diseases. The ease of such product distribution makes piglet treatment even more effective and reduces the transmission of infections between litters.

Dose

A fixed dose of an antimicrobial in a specific volume of water will never lead to a correct daily dose. Always dosing at for example 100g per 1000 litre drinking water, leads to under, or overdosing. Correct dosing can only be based upon the total bodyweight of the affected pigs, the percentage active of the final product and the daily dose of active ingredient per pig.

Huvepharma has developed a practical and freely available dose calculator for smartphones. This practical tool ensures the correct dosing for both in-feed and in-water medication on pig and poultry farms. The optimal dosage regime depends on the antimicrobial's profile. Three different profiles can be distinguished (Fig. 3).

- Time dependent molecules (for example, macrolides: Pharmasin, Tilmovet). Continuous medication is indicated for this group of antimicrobials. The time period during which the concentration is just higher than the Minimal Inhibitory Concentration (T >MIC) at the site of the infection determines the efficacy.
- Concentration dependent antimicrobials (for example, the aminoglycosides). For this category, a pulse medication will be most efficient. A peak concentration for a short time several times higher than the Minimal Inhibitory Concentration of the causative pathogen at the site of the infection will give the best results in field. Cmax/MIC is the most important parameter.
- Mixed properties (for example, the tetracycline group). As these antimicrobials have a time and concentration dependency, the total amount of drug determines the efficacy, so the 24 hour Area Under Curve/MIC is the key parameter.

With a loading dose (defined as a larger start dose), levels above the MIC can be reached much faster than using the standard dose (Fig. 4). All the pigs, including the sick ones, must consume their daily dose. Animals with acute infections may have a reduced water and feed consumption and should be treated with a suitable injectable veterinary medicinal product first.

The increasing interest for in-water use of medication emphasises the need for perfect water soluble veterinary products with proven stability. The responsible use of antimicrobials relies on the calculation of a correct daily dose and an adapted dosage regime.

Dissolutions in bulk tanks and proportioners should be done with care to ensure the highest success rate in the field. ■

Fig. 4b. Loading dose.