disarm

Disseminating Innovative Solutions for Antiobiotic Resistance Management

Best Practice Guides

Improving Animal Health by Using Adapted Feeding, Watering, and Feed Additives

PROLOGUE


CATTLE


PIGS


POULTRY


SHEEP

This guide is written as part of the DISARM project 'Disseminating Innovative Solutions for Antibiotic Resistance Management', funded by the European Union's Horizon 2020 research and innovation programme under grant agreement 817591.

The DISARM project aims to reduce antibiotic resistance through a focus on disease prevention and animal health, thereby reducing the need for antibiotic use. DISARM has a wide range of resources available via our website and YouTube channel. We also have a vibrant and knowledgeable community within our Facebook discussion group (we welcome you to join, simply click this link and answer some short questions to gain access), and wider social media channels: Twitter, Facebook, LinkedIn.

DISARM also promotes the multi-actor approach – different people (farmers, veterinarians, nutritionists and other advisors) working together towards improved animal health and farm performance. If you want to find out more about this, check out our toolbox to get started!

This guide was based on the information that was gathered during the DISARM project; it should not be considered as a complete reference book. It gives a useful overview with links to practical videos, abstracts, articles, testimonies etc., to facilitate good practices. Not all recommendations will be applicable or suitable for your farm and any interventions should be discussed with your farm advisor(s).

This guide is one of the 10 Best Practice guides made during the DISARM project. The 10 guides all have the goal to inform you about a specific topic in order to reduce the antimicrobial use in the livestock industry.

The other DISARM Best Practice guides can be found here.

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INTRODUCTION

This guide aims to inform you about best practices on adapted feed, water regimes, and additives to improve animal health and thereby reduce the need for antibiotic treatments.

A variety of synthetic feed additives including drugs and antibiotics are used in animal feeds to maximize the efficiency of production, product quality and to control diseases. Although the modes of action of antibiotic growth promoters are not fully understood, the main effects are thought to be mediated via the gastrointestinal microbial flora. In the European Union, the use of antibiotic growth promoters as feed additives have been restricted since 2006. Countries such as Australia and the USA are following the European example by either regulating the use of antibiotics in feeds or setting up programs to reduce their overall use. In this context, there has been increased interest in the use of biological products, including enzymes, probiotics, prebiotics, synbiotics, organic acids and plant extracts (phytobiotics), as alternatives to antibiotic feed additives in animal diets.

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FEEDING IN EARLY LIFE

Ruminants

Colostrum – mother's milk produced in the first hours after birth – contains a complex mixture of antibodies and proteins that actively participate in the protection of the neonate against pathogens and other environmental challenges (passive immune transfer).

Animals growing under an industrial rearing system need to be fed an adequate amount of colostrum during their first days of life to obtain adequate passive immune transfer and increase future productivity. It has been reported that mammals not fed colostrum in the first hours of life are more susceptible to diseases and mortality. Therefore, it is crucial to provide an optimal colostrum source.

Thus, feeding the newborn ruminants with adequate quantity of colostrum, as early as possible after birth, is an effective good practice to obtain good passive immune transfer for optimal protection of lambs/calves. In this way, their health is improved, and they are less likely to need antibiotic treatments for infections.

More information about colostrum quantities and administrations are available in these videos:

However, colostrum can cause direct transfer of paratuberculosis (Johne's disease) from mother to newborn, so it is important to have control measures in place.

Poultry

During the first week of life, broiler chickens undergo various developmental changes that are initiated during incubation. Ongoing development of the gastrointestinal tract and the immune system may affect the nutritional requirements of birds during this life stage. Despite the residual yolk which can provide nutritional support during the first days after hatching, growth performance is affected by the time in between hatching and first feed intake. Chicks – especially those which hatched early – have been shown to benefit from direct access to feed post-hatching, resulting in greater weight gain during the first week after hatch. Direct access to feed can be facilitated by using on-farm hatching.

Some useful feeding strategies for day-old chicks are:

- **Providing highly digestible feed:** A pre-starter should be very easy to digest to allow the chickens gain weight efficiently and quickly.
- **Providing fast energy:** High levels of activity in day-old chickens is essential for good feed intakes and requires a fast energy source. Activity scoring is performed by putting the chickens on their back, and measuring the time needed to return to their feet.
- **Providing antioxidants:** Newly hatched chickens lack antioxidants like Vit. E, Vit. C and Selenium. A specialized pre-starter can be supplemented with natural antioxidants. As a result, the antioxidant capacity of the small birds is increased, so that they can cope with stress more efficiently, now and in later stages of life.
- **Providing a defense shield:** Chicks have a weak immune system during the first days of life. To ensure optimal protection of the chicks, ingredients can be added that kill the pathogens on the one hand, and strengthen the immune system on the other.

Pigs

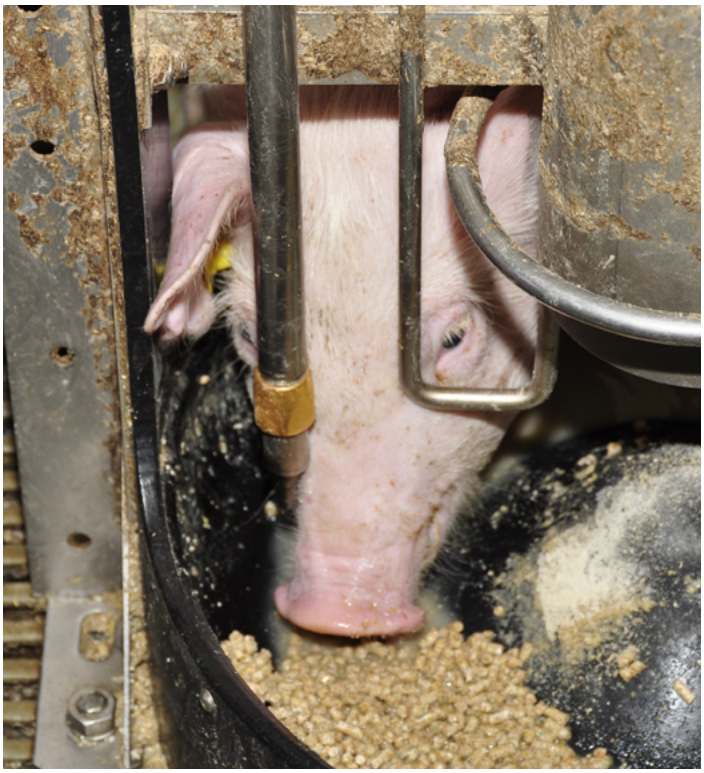
Early life nutrition influences the overall performance of a pig, with the results being observed in the grower/finisher phases. Investing in high-quality early life nutrition will translate into positive economic results and better health status of the animals.

The first feeding of colostrum must be supplied to new litters within hours after birth. Colostrum provides the necessary antibodies (Igs) to kick-start the piglet's immune system. In addition to Igs, colostrum contains high levels of protein, energy and Vitamin D that are vital to newborn pigs.

Offering a milk replacer next to a sow's milk in the first two weeks after birth and investing in a premium pre-starter diet around weaning provides short-, mid- and long-term benefits; heavier finisher pigs, more homogeneous batches and economic gains. Light weight piglets benefit the most from this nutritional strategy, as recent trials have shown.

Additionally, young piglet nutrition could be upgraded by supplementing with targeted feed additives.

More information about piglet nutrition is available in videos here and here.



FEEDING STRATEGIES IN ADULTS

Ruminants

Weaning

Weaning is an essential period for ruminants – milk-fed animals use just their abomasum for digestion, the rumen takes time to develop.

A suitable starter feed, roughage and water should be provided from the first week of life. This nutrition promotes the development of the ruminal microbiome, villi, and muscles. Providing the appropriate diet and allowing enough time for rumen development will help to maintain health and growth performance at weaning.

The transition period of the dairy cow

The transition period is considered critical for the dairy cow and refers to the 3 weeks before calving and 3 weeks after calving. This period can negatively influence the subsequent lactation of the cow, with implications on production and reproduction performance and a negative effect on profitability. The way in which this period is managed are reflected in the frequency of postpartum disorders (milk fever, abomasum displacement, placental retention).

The main measures to support the transition period:

1. Grouping of cows (ante partum and post-partum) in special areas (maternity) and maintaining good hygiene of the resting bed
2. Feeding a balanced diet in terms of electrolytes (dietary cation anion difference; DCAD)
3. Ensuring optimal levels of carbohydrates which stimulate propionate production
4. Urinary pH monitoring (pH less than 5.8 indicates decreased feed intake and immune imbalances, pH over 7.2 indicates postpartum paraplegia and placenta retention).

A Dutch veal farmer feeds his 1,100 veal calves with the FEEDR, an intelligent feeding robot. This robot can monitor exactly what the needs of the individual animal are and can therefore deliver the exact amount of feed.

The robot feeds the animals small portions several times a day, instead of a large portion at once. A major advantage of this is that the feed is always fresh. Consistently fresh feed ensures that the animals are healthier, thus reducing the use of antibiotics. See this video, which shows the other advantages of the robot system.

Poultry

Nutrition in the last week of broiler production

Normally, it is the week with the highest mortality. Therefore, in some conditions chickens are subjected to feed restriction.

It is very challenging for nutritionists to adjust for the nutritional needs of chickens in the last week of production. Some important parameters should be considered before formulating the diet for the last week, such as:

- Slaughter age of birds (28, 35, 42 or 49 days)
- Birds separated by sex or mixed with differentiated feeding
- Ways of feeding chickens in this phase ("ad libitum" or dietary restrictions combined with a light regime)
- Food availability by defined quantity per day or by more-or-less intense food withdrawal
- Purpose of the chickens produced

Pigs

Feeding strategies for weaned piglets

Weaning is a stressful period, and is often associated with diarrhoea and greater antibiotic use in young animals.

Creep/prestarter feed should be offered to piglets from about 4-5 days of age to help develop the piglet's enzymatic system to digest startch and proteins from vegetable origin rather than sows milk.

At weaning, piglets are mostly fed with dry feed – liquid feeding can improve feed intake, intestinal health and growth performance, but manual preparation is time consuming so consider investing in an automated feeder. Clean water should be freely available to piglets.

There are various post-weaning strategies that can improve production performance and/or reduce diarrhoea in piglets – a summary is provided in this article.

Feeding stations for group housed sows

Generally speaking, there are two ways of feeding sows: in groups or individually. Examples of group feeding are trough and floor feeding; for individual feeding these are feeding (lying) cubicles and feeding stations.

A major advantage of feeding stations for sows is that each animal can get the amount of feed required (based on Body Condition Score, fat thickness and/

or body weight) because there are multiple feeding curves. This is possible for both stable and dynamic groups. Furthermore, a record of sows that did not come to eat can be tracked daily.

Ideally, feeding stations will have a long return run, so that the feeling of satiety can occur during the sow's return to the group so she will go straight into the resting area, instead of moving back to the feeding station and disturbing other sows. Placing the drinking facility at the end of the return run also provides extra time for the sow, which promotes a relaxed environment for the sows.

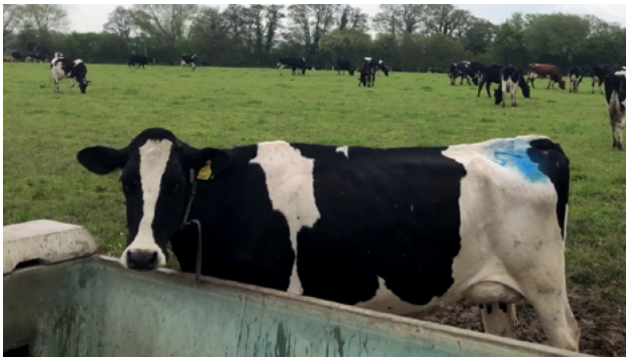
WATER REGIMES

Water is important for all animals as it is used for the regulation of body temperature, growth, milk production, digestion and metabolism of feed, as well as transport of nutrients and waste products in the body.

Water quality is very important to ensure good animal health. Contamination of the water source, the water pipes, or drinking troughs or nipples put animals at risk of infection and reduce the effectiveness of medicines distributed through the drinking water.

> ***"Access to tasteful good quality water ensures good water intake which results in its turn in sufficient feed intake. Animals that don't drink enough will eat less."***

Water disinfection and quality constitute an individual chapter within the DISARM project, thus you can find out more in the corresponding Best Practice Guide. Smart applications in drinking water are also a significant factor to expand farm biosecurity and animals' health status.



FEED ADDITIVES MOST COMMONLY USED

Pro-, pre-, and synbiotics

Probiotics

Probiotics have been defined by the World Health Organization as "microorganisms which, administered live and in adequate amounts, confer a benefit to the health of the host." Probiotics are thought to:

- destroy pathogenic microorganisms by producing antimicrobial compounds such as bacteriocins and organic acids,
- improve the gastrointestinal microbial environment by attaching to the intestinal wall thereby preventing attachment of pathogens,
- compete with pathogens for nutrients, stimulate the intestinal immune responses and improve the digestion and absorption of nutrients.

Prebiotics

Prebiotics are non-digestible (by the host) food ingredients that have a beneficial effect through their selective metabolism in the intestinal tract. Prebiotics include oligosaccharides, polysaccharides, natural plant extracts, protein hydrolysates, polyols, etc. Enzymes such as beta-glucanases and xylanases and short-chain fatty acids such as butyrate are examples of prebiotics which are usually added to feed formulations. Prebiotics can:

- selectively proliferate intestinal bacteria,
- promote immune functions and show anti-viral activity.

Synbiotics

Synbiotics are the joint preparations of probiotics and prebiotics, thus have the qualities of both. There are some reports on the effect of synbiotics on piglet performance including:

- enhanced immune function,
- improved average daily gain and digestion,
- the reduction of diarrhea morbidity and mortality,
- the ease of weaning stress response

> Supplementing ewes' diet with live yeast *S. cerevisiae* increases milk yield and total antioxidant capacity with a simultaneous downregulation of proinflammatory response. Click the link.

▲ Pro- and Prebiotics *help maintain a healthy gut by supporting calves' microbiome*

▲ *Ruminal buffers improve cows performance and health status*

▲ *Organic acids develop gut microbiome in piglet production*

Mycotoxin binders

Mycotoxins are particularly toxic substances, which are mostly produced by three genera of fungi: Aspergillus, Penicillium, and Fusarium.

Mycotoxin contamination of animal feed affects animals' immune systems resulting in greater susceptibility to diseases. Hence, mycotoxin occurrence increases antibiotic usage in livestock.

Several substances such as lucerne, zeolites, bentonite, and bleaching clays act as mycotoxin-binding agents and prevent intestinal adsorption of the toxin by the animal through its diet.

However, there is a risk that mycotoxin binders will also decrease the availability of dietary vitamins, amino acids, and minerals. To overcome these constraints, biomass that contains yeast, lactic acid bacteria, and conidia of Aspergillus is used as a second-generation binder.

Feeding the mycotoxin binder to lambs increased excretion of ergot alkaloids in feces by 38.5% and increased serum prolactin concentrations compared with lambs. Click the link.

How mycotoxin binders work

Essential oils as immunoregulators

Extracted oils from roots, seeds, leaves, bark, flowers, fruits and algae contain complex mixtures of phenolic compounds known for their antimicrobial, anti-inflammatory, and antioxidant qualities. The bioactive components in essential oils can modify cellular functions in the host and/or bacteria - in the right conditions, the interactions with cell wall components and lipid membranes can lead to bacterial cell death. A major issue is that over time bacteria may adapt and become resistant to the active phenolic components similar to antibiotics, thus their prudent use should also be considered.

Phytogenic compounds have also good potential as an alternative to antibiotics in animal production, both as growth promoters and as treatment for bacterial infections.

Carvacrol and thymol are the most studied feed additives in both ruminants and monogastrics.

The inclusion of oregano essential oil helped to maintain the body condition score of suckling sows, increased weight gain during the first week of life of piglets, decreased pre-weaning mortality and significantly decreased antibiotic use. Click the link

Amino acids-Vitamins-Minerals

Amino acids, minerals and vitamins are significant precursors for synthesis of molecules capable to regulate both the immune and antioxidant systems in animals. An optimum balance between pro-oxidant and antioxidant compounds ensure an improved immune system function to fight off infectious diseases. In this context, methionine and lysine could contribute to good animal health.

Moreover, vitamin E and selenium appear to be a well-justified combination as feed additives to improve the health status of animals.

The supplementation drinking water with a product containing Bacillus licheniformis and Bacillus subtilis, betaine, vitamins and micro-elements (1g/litre) reduced broiler mortality by 3.5%. Click the link.

Dietary supplementation with rumen-protected lysine and methionine in dairy sheep improves their innate immunity through downregulation of proinflammatory response. Click the link.

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More from the DISARM Best Practice Guide Series

- Internal Biosecurity
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- Precision Livestock Farming for Early Disease Detection
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- Drinking Water Quality
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