



Perspectives of Applying FEED ADDITIVES
via Water for Drinking



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Introduction: There is a need for differentiation:



- FEED ADDITIVES administered via
 - water for drinking vs. in a liquid diet (added to the water vs. added to the diet that is offered in a liquid form)
- SUBSTANCES added to the water under the “umbrella” of
 - feed legislation vs. further regulations (feed additives vs. biocides etc.)
- PERSONNEL/LOCATION of the adding
 - feed industry vs. owner of the animals (farm level) (non-primary-producer vs. primary-producer)

Introduction/background



- **Gaining efforts of the feed additives' industry to get an approval for administering feed additives via drinking water**
 - feed additives: expected in the feed → but application via water?
 - is there really a need for a further way of application?
 - primarily driven by economic interests?
- **Current techniques for offering water in modern units of farmed animals**
 - exact dosing (established for drug application/veterinary treatment)
 - allow an **immediate** reaction (within hours! contrary application via feed)
 - enables the farmer/feed industry to react without veterinarians (costs↓)
- **Reservations regarding this trend (science/official feed control/EFSA...)**
 - how to control the "double application" (feed and water?)
 - how to avoid excess application? → impact on food safety/environment?
 - how to handle this matter regarding aspects of legislation?



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How to understand the trend/the efforts regarding an application of feed additives via water for drinking?



- **Commercial interests of feed additives producing companies**
 - **stimulating their use/demand on the market**
- **Increasing volume/relevance of complementary feeds**
 - **animal owners want to apply without involving the feed producer**
- **Improved technical equipment on farms that allows a precise dosing**
 - **techniques implemented for veterinary drug application**
- **To elude impairing effects of the feed technology on the feed additive (especially of temperature, pressure, ...)**
 - **advantages described later on**
- **Veterinary practitioners can offer something that is not belonging to the "antibiotics" but might result in benefits for the animal/herd?**
 - **image of treatment**

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EU – Feed Legislation



- **"Feed additives" (definition/use... EU Regulation No 1831/2003)**
 - substances, microorganisms or preparations, other than feed materials and premixtures, which are intentionally added to **feed OR water** to perform functions (Article 6: categories)
- **Is there an approval to apply the feed additive via water?**
 - specific conditions / limitations and remarks
 - specific demands regarding labelling
- **"Drinking water/water for drinking"**
 - offered separately to enable a water consumption without feed
 - parameter of quality: "appropriate quality" (without further specifications)
 - any restriction is not allowed for animal welfare reasons



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Categories of feed additives in the EU and chances/ perspectives for their application via water for drinking



Feed Additives (categories/groups)	Application via feed/diet	Application via water for drinking
Technological Additives	+++	(+) / +++
Sensory Additives	+++	(+)
Nutritional Additives	+++	++/+++
Zootechnical Additives	+++	++/+++
Coccidiostats/Histomonostats	+++	-

Übers. Tierernährg. 2019, 43, 205 - 248



FÜR UND WIDER EINE VERABREICHUNG VON
FUTTERMITTELZUSATZSTOFFEN ÜBER DAS TRÄNKWASSER

Pros and Cons of Supplementing Feed Additives via Water for Drinking

von by

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EU-Legislation regarding “Feed additives“/use/application...
(Regulation No 1831/2003; Regulation No 183/2005; Regulation No 767/2009)



- Regulation No 183/2005: Article 5
 - “For operations at the level of [primary production of feed...](#)”
(c) mixing of feed for the exclusive requirements of their own holdings [without using additives or premixtures of additives with the exception of silage additives](#)
- ... when using additives or premixtures of additives (with the exception of silage additives) feed business operators shall comply with the [provisions of Annex II](#)
 - loss of the status “primary production of feed”
 - consequences regarding facilities and equipment, personnel, production, quality control, storage and transport, record keeping,...
 - HACCP principles/approval, not registration only
- Consequences for the farmer / owner of the animal
 - [How to solve the problem?](#)



How to administer additives via water for drinking?
(Regulations: No 1831/2003; No 183/2005; No 767/2006)



- **Accept the status of “Non-primary producers”**
 - consequences described before, based on No 183/2005 (directive on feed hygiene)
- **“HACCP light” as implemented in some member states**
 - there are exceptions regarding urea, distinct organic acids, amino acids
 - “low level documentation” regarding used amounts...
- **The only way out of this situation for “primary producers” (farmers):**
complementary feeds (a special compound feed with elevated contents of nutrients or/and additives)

in cases of additives with max. levels: “100 x rule”
it means the highest allowed level is 100 times higher than in the compound feed (No 767/2009)



Whenever an application of feed additives is intended – there are some aspects that need to be considered before (as it is necessary in the case of medication: KAMPHUES 1996; Guidelines, German Ministry for Agriculture, 20/10/2016)



- Dosing precisely as possible/to achieve an efficient supply?
- Water solubility/stabilized suspension/risk for demixing?
- Negative influences *from* the water as well as *on* the water?
- Risks for personnel due to handling (for example: org. acids)
- Potential effects regarding the contamination by/of additives?
- Effects regarding the environment (for example copper, zinc)
- How to control an appropriate application?
- Consequences for the established techniques for feed/water supply
 - for example: corrosive effects of some organic acids on the technical equipment for watering

Preconditions for precise administering feed additives are knowledges on water intake/influencing factors



Species	Ratio (l water/kg DM intake)
horses	4
cattle	4
sheep	4
pigs	3
ducks	3
chicken	2
laying hens	2
dogs	2.5
cats	2.5
rabbits	2.5
budgerigars	1.0
gerbils	< 1.0

KAMPHUES et al. 2019

Water consumption – influences of significance:



• Ambient temperature

- dairy cows (4 vs. 32 °C): 2.4 times higher intake
- laying hens: per 1 °C plus 7 – 9 % water intake
- sport horses, high ambient temperature: 7 l/1 kg DM
- fattening turkeys, at heat stress: 9 l/1 kg DM



• Diet composition/formulation

- sodium/potassium content → urine volume ↑
- roughage/fiber intake → fecal mass/water ↑
- protein content → urinary N excretion ↑



• Kind and level of performance/diseases

- lactation: amounts of milk produced
- activity: water losses due to sweat
- kidney diseases: for example due to ochratoxin effects/intoxication



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The water „use“ of animals is not always the real intake

→ undesired effects on litter quality/amounts of slurry ...



• Water spillage/losses at drinking

- techniques of drinkers/type of offering/technical faults
- in pigs: about one third of released water was lost
- in poultry: 3.5/10/20 % of the released water were lost

• Activating the drinker without ingestion

- sign of missing wellbeing (frustration/depression)
- activity due to heat stress (preference of cool water)

• Water is used for cleaning the water lines/techniques

- flushing spontaneously to avoid contaminations observed or established in an automatic program

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Veterinary aspects of administering feed additives via water for drinking



• Effects on the quality/composition of the water itself

- changes in chemical/physical properties (pH ↓ → secondary effects)
- increased availability of nutrients (organic/inorganic substances) - microflora ↑
- favoured formation of "biofilm" (at the inner surface of the pipes)

• Effects on the animals (individuals/herds)

- changes in water consumption (sometimes intended)?
- water intake related to ambient temperature determines additive intake
- intake exceeding requirements: adverse effects

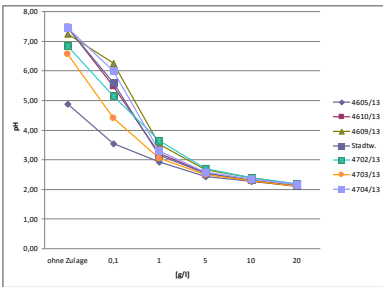
• Effects on the environment as well as on food safety

- surplus of nutrients in faeces/urine/excreta → environmental load
- higher retention/accretion in animals?
- undesired levels of nutrients in tissues/organs (Vit A, copper in the liver...)

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Consequences regarding the drinking water
→ chemical properties/palatability?



pH values in drinking water (field samples) after adding increasing amounts of formic acid (85 %)
KAMPHUES et al. 2013

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Consequences regarding the quality of water for
drinking/watering technique
→ "biofilm"



Formation of "biofilm" in the water pipelines/watering technique:

- "Biofilm" characterized by a solid build up at the inner surface of the pipelines/ technique consisting of inorganic and organic compounds settled with certain microorganisms
- Favoured by temperature, surface structure and material of watering technique, water flow rates, high contents of minerals (Mn?), supplemented organic substances (substrate for bacteria within the system)

Consequences:

- continuous contamination of passing water
- technical dysfunction
- temporary binding/complexing of drugs
- later on: release of drugs (?)

→ Residues in food due to unintended treatment
(in spite of correct withdrawal time)



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Indisputably there are interesting advantages for
administering feed additives via water for drinking



- to avoid negative effects on the feed additive by the production process (temperature, pressure, feed constituents)
 - see arguments for a "post pelleting application" of probiotics, enzymes, ...
- to protect the feed additive against the intragastric milieu with its hydrochloric acid concentration, proteolytic activity etc.
 - passage rate of the liquid/solid phase through the stomach
- to react immediately, without the need for a "new" diet when an additional supply of distinct feed additives makes sense
 - for example: biotin to combat foot pad dermatitis in poultry
- to enable a sufficient nutrient supply (like amino acids, vitamins, trace elements) inspite of insufficient dietary intake
 - inducing moulting by feed restriction in laying hens
- to use the differences in the consumption behaviour regarding feed intake and water intake (for example at heat stress: water intake)
 - as an example: vitamin C in heat stressed laying hens
- to facilitate innovative approaches of energy and nutrient supply of newborn animals which do not ingest "diets"
 - instead of an iron injection in piglets at the 2nd/3rd day
- to use "combined effects" of distinct feed additives like formic acid that act in the water and in the animal (against Salmonella ...)
 - to ensure an appropriate water quality and Salmonella prophylaxis

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Are there consequences regarding the efficacy of feed additives administered via feed or via water for drinking?

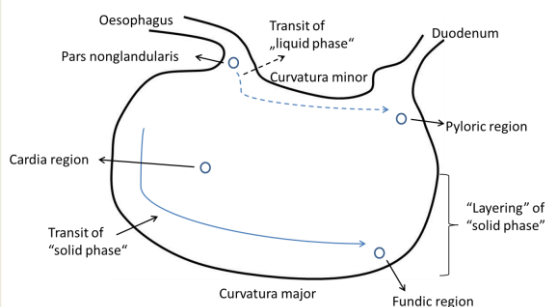


- **In general: estimated as equivalent/equally effective** (supposed by diverse official institutions)
- **But maybe there are changes/variations regarding**
 - the passage of the stomach (fluids will enter the small intestine much faster)
 - exposure to strong acid milieu in the fundus part?
 - biorhythm of intake (differences between dry feed/water)
- **At the stage of applying for an approval (...via water!) producer**
 - have to guarantee solubility or at least a homogeneous distribution and "stability" of the additive in the drinking water
- **Special needs regarding labelling**
 - consider the parallel nutrient supply by the feed
 - to avoid an exceeding of upper levels set/fixed in the directive 1831/2003

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Is there a difference in receiving an additive via feed or water? → figure regarding stomach passage in pigs (KAMPHUES 1988)



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Comparing pros and cons of an application of additives via water → arguments of specific veterinary interest/relevance



- **In cases of an impaired/delayed feed intake**
 - in piglets: higher and earlier intake of water than of dry feed in suckling period
 - in diseased animals: water intake is maintained longer than feed ingestion
 - **In cases of an intended higher intake than achieved by feed solely**
 - application of organic acids (prevention of distinct infections)
 - extra supply of amino acids, vitamins, minerals, trace elements that could support the animals under specific challenging conditions
 - **In cases of advantages due to a more continuous intake**
 - pregnant sows: one meal per day - but frequent consumption of water
- **Common to all: there are aspects of "dietetics" → "animals might have a profit by a specific dietary treatment"**

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What are the main risks – related to an application of feed additives via water for drinking?



- Neglecting the parallel intake of the nutrient/substances via feed and via water!
 - the use of complete diets is quite common
- Neglecting the feed legislation and consequences for the farmer vs. producer of the complementary feed!
 - compliance relevant state of affairs!
- Neglecting potential effects of the feed additive on the water/animal/food/environment
 - needs to be considered in the official feed control

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Perspectives from the view of veterinary nutrition



- For decades drinking water is used for application of drugs as well as of vaccination (alive pathogens) in herds of poultry and porc production
- One part in the puzzle of veterinary treatment in the “post antibiotic era”
- Reflecting the trend towards “specific” dietary management independent from the feed industry focused on “standard diets”
- Critical/prudent use is mandatory (evidence for efficacy/mechanisms to understand/to explain supposed benefits?)
- Whenever the “normal” feed consumption is impaired/hampered, the water for drinking offers a chance for voluntary intake

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Sometimes just new ideas are required/some people thinking besides conventional procedures (examples):



- Adding “natural” sensory additives (“flavoring”)
 - to stimulate water intake in cats → urinary concretions, also in further species? Infections of the urinary tract?
 - ZANGHI et al. 2018, Am. J. Vet. Res. 79, 1150-1159
- Adding “antibodies” (from eggs, from plasma proteins, intestinal mucus, milk)
 - avoiding the negative impact of feed technology
 - LI et al. 2015, J. Anim. Sci. Biotechnol. 6, 40 ff.
- Adding a “palatable iron compound” to the drinking water for newborn piglets
 - instead of an iron injection, would be highly welcome!
 - KAMPHUES 2016/2017

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Opinion of the EFSA regarding the application of feed additives via drinking water (EFSA 2010)



Administering of feed additives via water for drinking	
is absolutely forbidden	for coccidiostats/histomonostats
should not be licensed	for all additives with upper dietary levels (vit A/vit D/trace elements) and the same is valid for additives that might result in imbalances or diseases/intoxications (amino acids/urea)
makes no sense	feed additives that affect primarily the feed itself (like anticaking compounds, enhancer of pellet quality ...)
is without any risk for the animals, food safety, and the environment	vit B/formiates/flavourings/vit K, vit C, vfa, citrates, plant extracts (origanum), menthol ...

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The application of feed additives via water for drinking - pros and cons – (KAMPHUES et al. 2019)



Kind of feed additive	pros	cons
amino acids	additional supply for performance/health	intake above requirement levels → higher N excretion, environment?
trace elements	earlier/additional supply for newborns/after hatch	higher accretion in the body/organs, environmental load (?)
vitamins	supply independent of a normal feed intake, protective effects	higher accretion (vit A → liver), toxic effects (not only in cats)
org. acids	hygiene within the watering technique	taste of the water, technical problems, corrosive effects
probiotics	avoiding negative influences of feed technology	alive microorganisms (→ "biofilm")
prebiotics	faster passage of the cranial part	substrate? favoring microbial growth?

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Official opinion of EFSA regarding administering additives via drinking water



- **NO/NEVER an approval for coccidiostats/histomonostats via water**
- **Not allowed for all nutritional additives, for which**
 - upper levels are established (like vit A, vit D, copper, selenium, ...)
- **Disputable for all other additives that should not harm**
 - the animals/the feed safety/the environment
- **Risks for an oversupply/non accurate dosing that could**
 - affect adversely safety of handling/of food/and the environment

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Summary/conclusions:
Without neglecting the risks - don't forget the chances



- a highly palatable water for piglets including iron as an additive
→ no further need for an iron injection?
- an additive of plant origin that could stop sudden abnormal behaviour like cannibalism in pigs and poultry?
- a drinking water enriched with nutrients and additives developed for underweight newborn piglets?
- “complementary feed” for chicken suddenly affected by foot pad dermatitis (biotin, zinc, S-AA, ...)?
- additives for urine acidification in lambs, fattening bulls, periparturient sows (urolithiasis/PPDS)
- “probiotics” in the first consumed water after hatching ... ?
→ “dietetics in food producing animals”

Consequences of the trend for an increased application
of feed additives via water for drinking



- **Official feed control**
 - more feed business operators - control expenditure↑
 - diversity of “complementary feed” (enriched with one or more additives)
- **Scientific discipline of animal nutrition**
 - primary goal: meeting requirements - and highest efficacy
 - avoiding unintended accretion in animals/minimizing environmental pollution
- **Farmer/veterinary practitioner**
 - responsibility when restrictions are neglected (→ copper, zinc)
 - dietary treatment vs. dietetics
(animals might have a profit from a specific dietary treatment in response to specific conditions - impaired digestive processes...)

Thank you for your attention!



Isabel Winarsch für VolkswagenStiftung, Herrenhausen Late “Tierisch lecker? Richtig füttern und futtern!”
