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**Organic Animal Husbandry systems –
 challenges, performance and potentials**



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Replacement of anthelmintics, antibiotics, and synthetic vitamins in organic animal husbandry – the contribution of the Horizon 2020 project RELACS

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Key words: gastro-intestinal nematodes, mastitis, vitamins

Introduction

Organic farmers adhere to high standards in producing quality food while protecting the environment and ensuring animal health and welfare. However, organic farming needs to improve continuously to keep meeting its ambitious objectives. The project 'Replacement of Contentious Inputs in Organic Farming Systems' (RELACS) fosters the development and adoption of tools and techniques to further reduce the use of external inputs on organic farms.

RELACS takes far-advanced solutions forward. With regard to animal husbandry, this is brought about by

(i) developing integrated endoparasite control strategies for ruminants by exploiting bioactive forages (heather) and the biocontrol agent *Duddingtonia flagrans*.

(ii) reducing dependency on antibiotic use in dairy cows by transferring Animal Health and Welfare Planning protocols and by refining the use of essential oils.

(iii) exploring the potential for reduction or replacement of synthetic/GMO produced vitamins by validating requirement definitions and by developing GMO-free vitamin B production.

This paper gives an overview of the overall work plan related to livestock and presents selected results obtained during the first 18-month period of RELACS. Outcomes of the RELACS-survey on the use of antibiotics and anthelmintics are presented by Chylinski *et al.* in these proceedings.

Replacement of anthelmintics

Material and methods

RELACS will develop two complementary techniques to reduce application of anthelmintics in livestock production.

First, the efficacy of heather against ovine gastrointestinal nematodes is determined in feeding experiments and will be validated on farm in a multi-actor activity involving organic sheep stakeholders (farmers, farmers' associations, advisors, scientists). Samples of heather (mainly *Calluna vulgaris*) were collected in the UK (Scottish Highland), Switzerland (Alpine), Germany (Lüneburg Heath), Norway (West coast) and Spain (Mediterranean) and anthelmintic activity was tested *in vitro*. Associations between compound profiles in heather extracts with respective anthelmintic efficacy will be investigated.

Second, the efficacy of the nematophagous fungus *Duddingtonia flagrans* to reduce pasture infectivity is investigated with or without additional heather consumption. After a series of combined *in vivo/in vitro* tests using lambs infected with *Haemonchus contortus*, adoption of both

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strategies to different pedo-climatic conditions will be explored on farm, using naturally infected sheep or goat flocks.

Results

In vitro efficacy of *C. vulgaris* is variable across samples originating from different countries. Extracts of heather collected in spring had higher anthelmintic effect compared to those collected in winter. Extracts originating from the UK and Spain were the most efficacious and that from Norway was the least efficacious. In the feeding trial, both heather as well as the feed additive containing fungal spores were readily eaten by sheep. On average, lambs consumed 0.27 kg of heather/day. *D. flagrans* reduced larval development from faecal cultures by about 95%. Effects of and interactions with heather remain to be analysed.

Replacement of antibiotics

Material and methods

RELACS will deliver two strategies to reduce antibiotic use in dairy production.

Together with experienced advisors from France, the UK and Spain, experienced Animal health and welfare planning (AHWP) trainers from FiBL (Switzerland) have developed a protocol for implementing the AHWP approach in dairy farms.

Antibacterial and anti-inflammatory effects of 10 essential oils frequently used on French farms against *E. coli*, *Staphylococcus aureus* and *Streptococcus uberis* have been evaluated through a series of chromatograms and two series of aromagrams. In addition, toxicity tests (tissue cultures) were performed and bibliographic work and feedback from farmers' experiences was taken into consideration for selecting essential oils for on-farm trials.

Essential oils and the new RELACS AHWP protocol (alone and combined) for mastitis control are validated on-farm in three countries (open ended multi-actor activity) in collaboration with two existing French farmer groups (FEVEC and ADAGE35), Soil Association in the UK and organic dairy farmers from the network of ECOVALIA in Spain. Effects of the treatments will be evaluated based on (i) clinical healing as observed by farmers, and (ii) complete healing based on the results of bacteriological analyses and somatic cell counts before and after treatment.

Results

The RELACS AHWP protocol was developed and tested on-farm. Feed-back by farmers and advisors show excellent acceptance of the protocol in all countries. Farm data analysis is ongoing. Based on the comparative analysis of 10 candidates, two essential oils (one with anti-inflammatory and one with antibacterial properties) were selected for on-farm trials. A RELACS essential oil protocol (Fig. 1) was developed and is currently validated on 73 organic dairy farms in three countries.

Replacement of synthetic vitamins

Material and methods

RELACS will provide updated quantitative data on vitamin requirements of organic livestock and develop competitive non-GM high-yield yeast production strains to reduce B and E Vitamin supplementation.



Effects of reducing Vitamin B2 supplementation in diets were evaluated in feeding experiments with layers, broiler breeders and broilers. For each category, health, welfare and production at different levels of supplementation were recorded during the rearing period (broilers and breeders), or during five months of egg production (layers and breeders). To increase the supply of Vitamin B2 from acceptable sources, RELACS explores the potential for the selection of high Vitamin B2-producing non-GM yeast strains by established screening methods.

RELACS reassesses Vitamin E demand and availability in modern diets for ruminants in organic farming systems through targeted analysis of large datasets with a focus on the relationship between basal feed type and quality, stage in animal production cycle, plasma and milk levels of α -tocopherol, and milk excretion of α -tocopherol.

The proposed concepts and revised diet recommendations will be assessed in on-farm trials in commercial farms to rapidly accumulate first-hand information in real-world conditions.

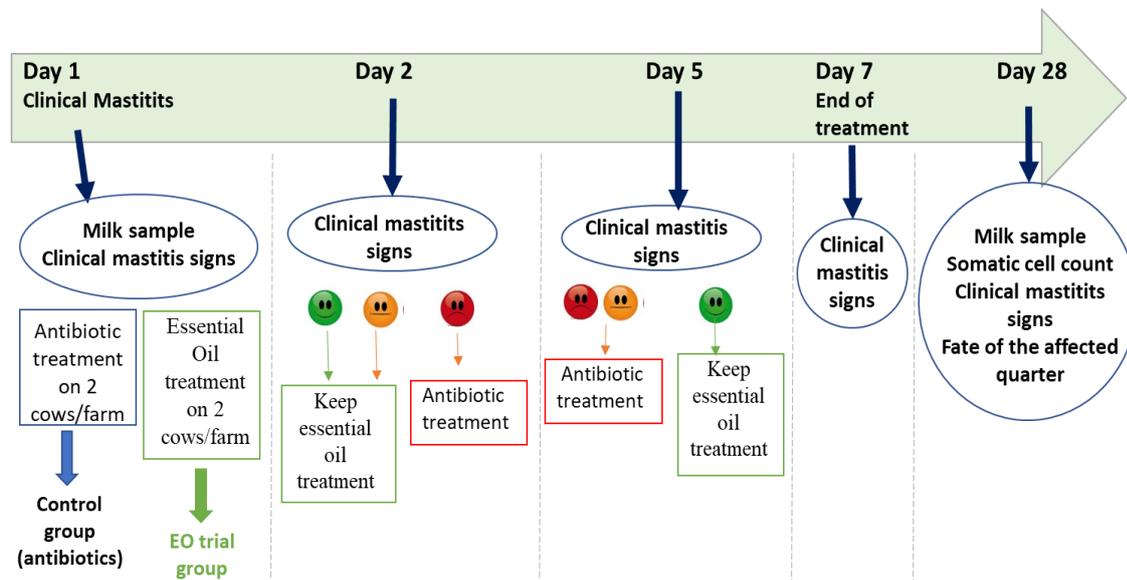


Figure 1. RELACS essential oil application protocol for on-farm validation

Results

The survey on Vitamin E demand and availability and experiments with broiler breeders and broilers are ongoing. The feeding experiment with layers indicates that a supplementation of 3 mg Vitamin B2 per kg feed for laying hens is safe with respect to animal health (e.g. neuronal dysfunctions) and performance, and a supplementation level of 4.5 mg/kg does not provide further advantage.

Wild type strains of yeast were screened for their Vitamin B2 production properties. Two of them were identified as overproducers and are now further evaluated.

Discussion

After the first 18 months of RELACS, many experiments under lab or small-scale experimental conditions are completed and the project team will now focus on multi actor activities and validation. Several positive outcomes are ready to be included in on-farm trials: *D. flagrans* is

a very promising tool to reduce pasture contamination with helminth eggs and it can be combined with other efficient methods, e.g. tannin-rich heather. Dairy farmers and advisors across Europe readily adopted new methods to secure animal health and are willing to test the efficacy of antibacterial and anti-inflammatory essential oils. Vitamin B2 supplementation can be reduced by 30% in layer feed and new sources of this vitamin are being investigated. The potential of these diverse tools to reduce anthelmintics, antibiotics and synthetic/GM-produced Vitamins on organic farms is huge and will now be quantified on-farm under different climatic and socio-economic conditions.

The market for organic dairy products, meat and eggs is exceedingly sensitive to problematic practices with effects on animal welfare (inefficient treatments of mastitis and helminths due to resistant pathogens), the environment and biodiversity (excessive use of anthelmintics), food quality, indirect risks for human health (routine and large scale use of antibiotics in dairy production) and use of vitamins from problematic sources. The solutions brought about by RELACS are therefore essential to enhance organic production, quality and long-term stability of the organic market.

Suggestions for research and support policies to develop further organic animal husbandry

Besides the use of more robust and resilient genotypes, contentious external inputs can be reduced at various levels in the shorter term. The mechanism of self-medication has the potential to reduce antibiotics and anthelmintics and to mitigate metabolic imbalances by allowing feed selection. Treatment with medicinal plants would be particularly promising in young animal's diseases, which are one of the main causes for antibiotic use in livestock. While several European projects addressed gastro-intestinal nematodes in ruminants, alternative control measures for many other internal and external parasites of livestock are largely missing.

The introduction of natural inputs with the potential to replace synthetic or GM-produced inputs encounters several regulatory obstacles, which are often not passed by promising new developments. The RELACS policy brief (<https://relacs-project.eu/resources/policy-documents/>) describes five steps towards more appropriate regulation for natural substances in animal health and welfare.

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References

A comprehensive list of references can be found in the scientific papers resulting from the project. Please check for updates under <https://relacs-project.eu>