



WP6.3 Improving the gastro-intestinal health and welfare of laying hens by the use of dietary plant additives

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Background

- Worm infections play a significant role in hens with access to outdoor areas, i.e. organic production
- *Ascaridia galli* is one of the most abundant nematodes in poultry
- Severe infections with the parasite impair hen welfare and production results
- Use of anthelmintics in organic production is restricted due to constraints regarding marketing of eggs
- Alternative to anthelmintics are needed in worm control

Objective

- To identify plant-based feed interventions that support hen robustness against parasitic and bacterial diseases
- Ideal properties
 - Antiparasitic effect
 - Antibacterial effect
 - Immune stimulation

***In vivo* experiments**

- 3 experiments applying an *Ascaridia galli* challenge model
- 1 experiment with naturally infected hens from organic egg producer
- 1 on-farm experiment

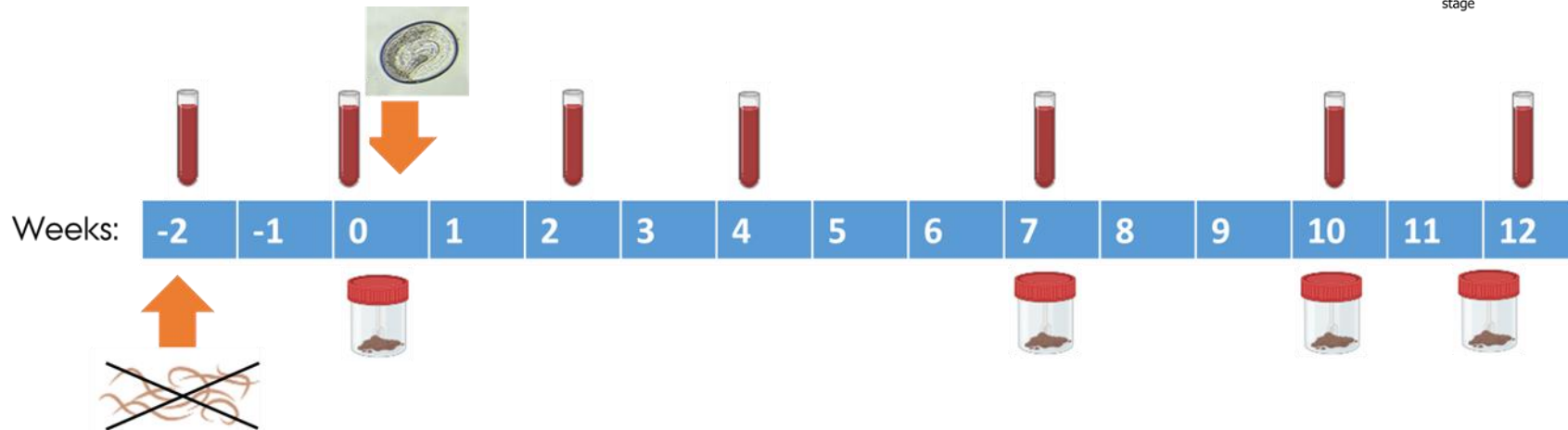
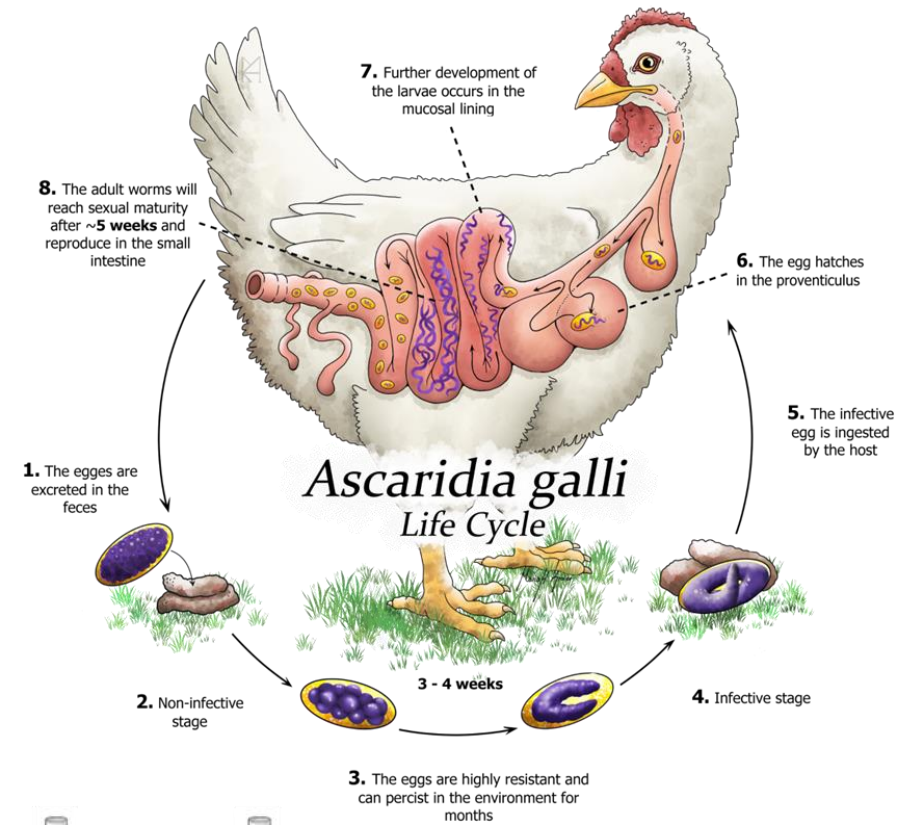
***In vitro* experiments with ethanolic plant extracts**

(kindly provided by Marina Spinu and Vasile Cozma, USAMV, Romania)

- Marigold *Calendula officinalis*
- Garlic *Allium sativum*
- Pumpkin seed *Cucurbita pepo*
- Coriander seed *Coriandrum sativum*
- Wormwood *Artemesia absinthium*
- Summer savory *Satureja hortensis* L.

PPILOW –WP6.3 Infection model *Ascaridia galli* challenge

- Arrival of hens (age: 18-20 weeks)
- Deworming of hens with Flubendazol (Flubenol vet.) or Fenbendazol (Panacur vet.)
 - Effect on *Capillaria spp.* found to be insufficient
- Oral infection with 500-1000 infective *A. galli* eggs



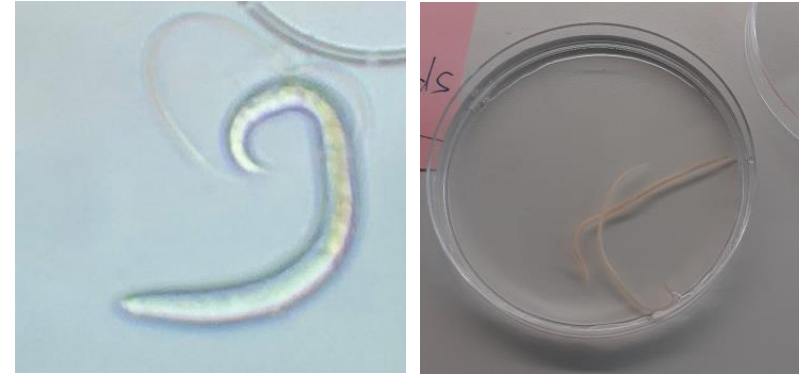
Outcome variables

- Performance:
Egg production, weight gain, feed intake
- Gut health:
Faecal dry matter, faecal pH, quantity of selected bacteria, organic fatty acids in ileal and caecal digesta, plasma colouration (gut integrity)
- Parasitology:
Worm eggs/g faeces (EPG), worm burden, *A. galli* specific IgY in serum
- Immunocompetence:
Differential leucocyte counts, mitogen response of lymphocytes, phenotype of intraepithelial lymphocytes, Ig production potential in gut mucosa

Outcome variables

In the presence of ethanolic plant extract

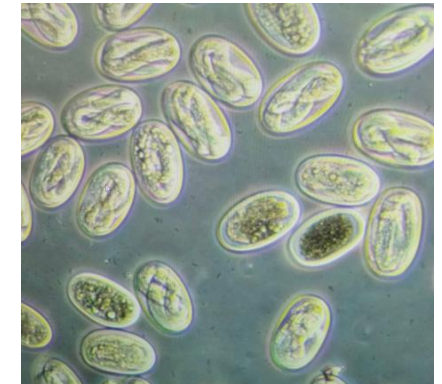
- Larvae mortality after hatching
- Adult worm mortality
- Immune stimulation
 - Mitochondrial activity of macrophages (HD11 cell line), nitrogen oxide production
 - Lymphocytes isolated from hen blood
 - Proliferation, activation marker expression, mitochondrial activity, and mortality



In vitro experiments

-Effects of plant extracts

	Anthelmintic		Immune stimulating	
	Larvae mortality	Adult worm mortality	Macrophage activation	Lymphocyte activation
Pumpkin, <i>Cucurbita pepo</i>	😊	😊	😊	😊
Summer savory <i>Satureja hortensis</i> L.	😊	😊	😊	NS
Garlic <i>Allium sativum</i>	😊	😊	NS	😊
Wormwood <i>Artemesia absinthium</i>	😊	😊	😊	NS
Coriander <i>Coriandrum sativum</i>	😊	😊	😊	😊
Marigold <i>Calendula officinalis</i>	😊	😊	NA	NA

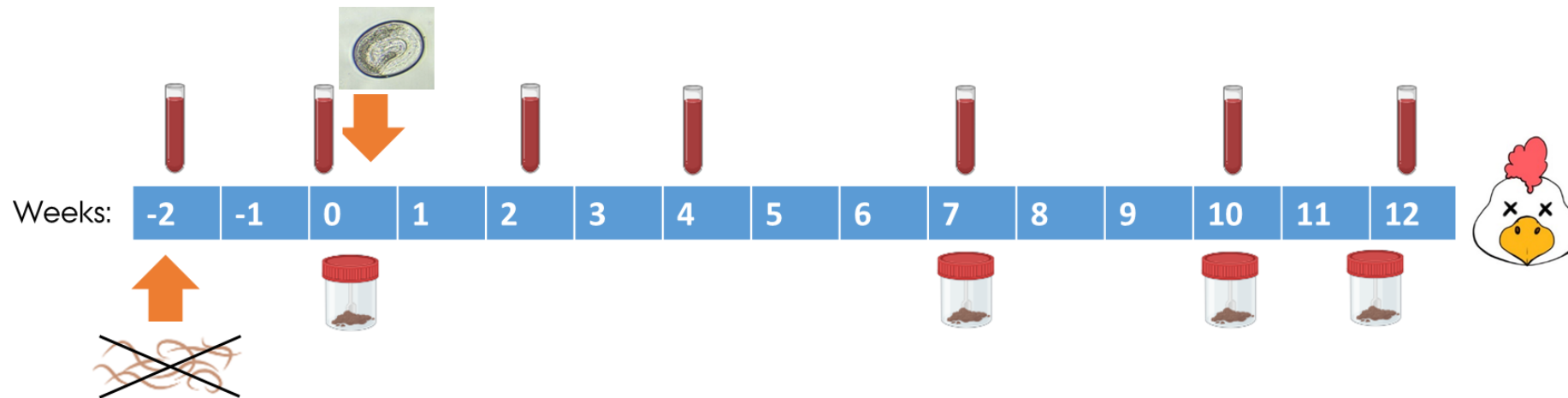


Fermented feed additive

-EP199 (FEXP), a fermented product based on rapeseed meal and seaweed (Fermentation experts)

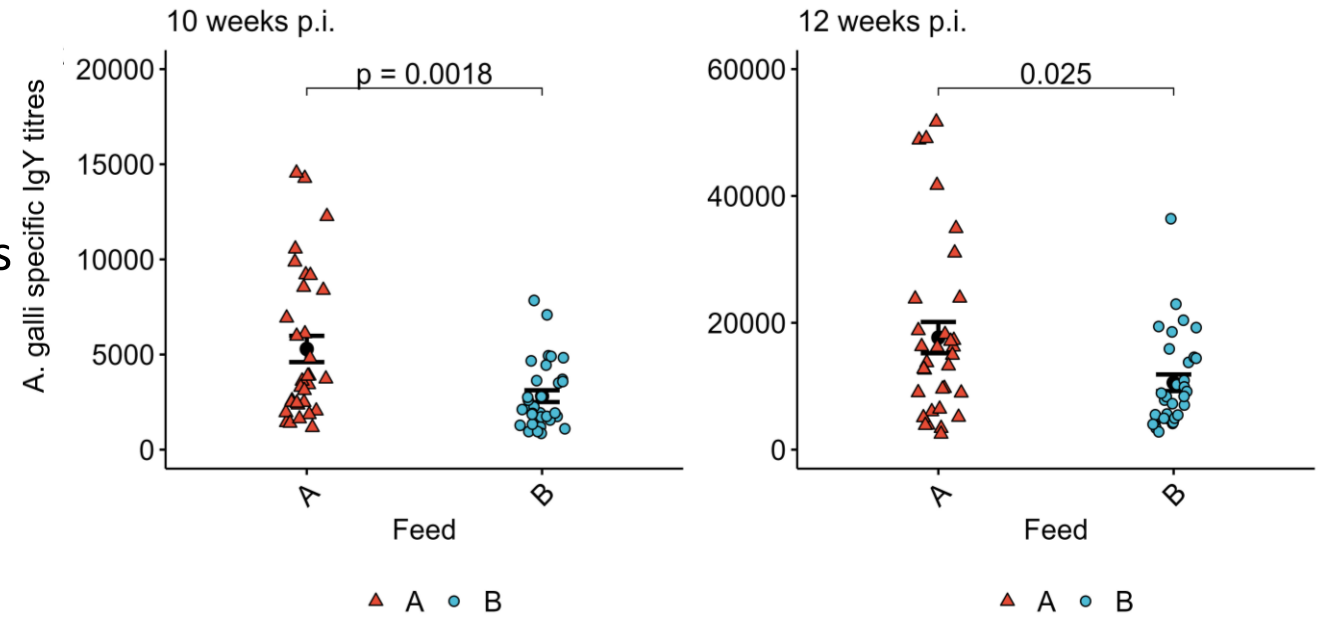
96 hens/dietary treatment, 16 pens/dietary treatment, 6 hens/pen (192 hens in total)

Feed	Group name
Control	A
EP199, 6%	B



Effect of feed supplement EP199

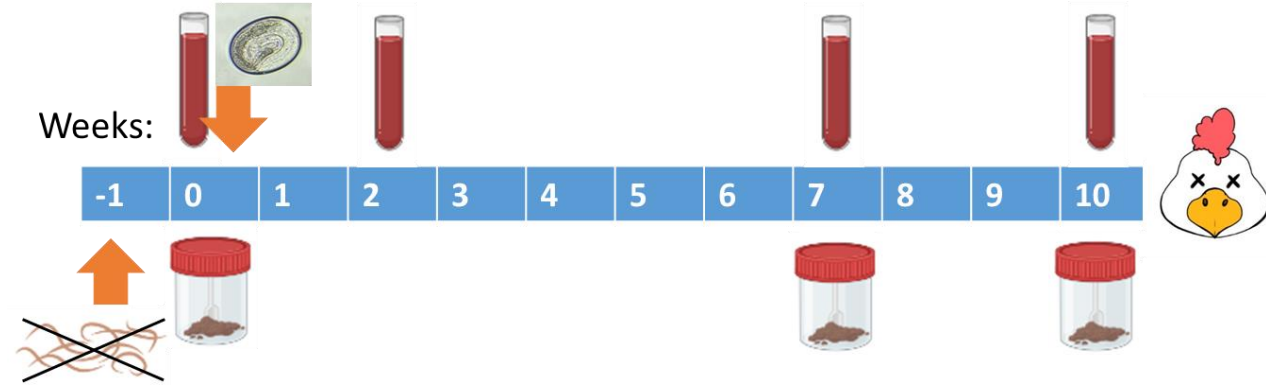
- No effect on performance
- Gut health:
Caecal concentration of short chain fatty acids (acetic acid, propionic acid and butyric acid) was higher when hens were supplemented with EP199
- Parasitology:
No effect on EPG or worm burden
Concentrations of serum *A. galli* specific IgY were lower in hens supplemented with EP199
- No effect on immunocompetence



Dietary plant additives

24 hens/dietary treatment, 4 pens/dietary treatment,
6 hens/pen (96 hens in total)

Plant additive	Concentration in feed	Experiment #
None (Control)	-	2+3
Garlic	1%	2
Chokeberry	1%	2
Garlic/Chokeberry	0.5% /0.5%	2
Garlic	2%	3
Pumpkin seeds	2%	3
Coriander seeds	2%	3



Allium sativum



Aronia melanocarpa



Cucurbita pepo

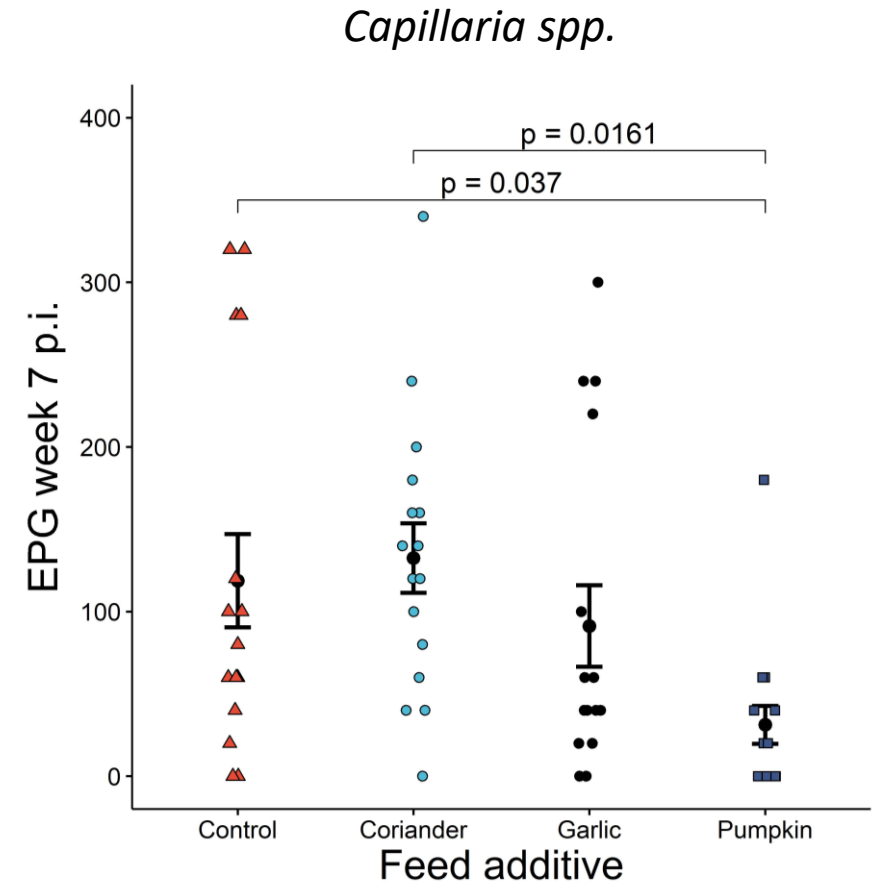


Coriandrum sativum



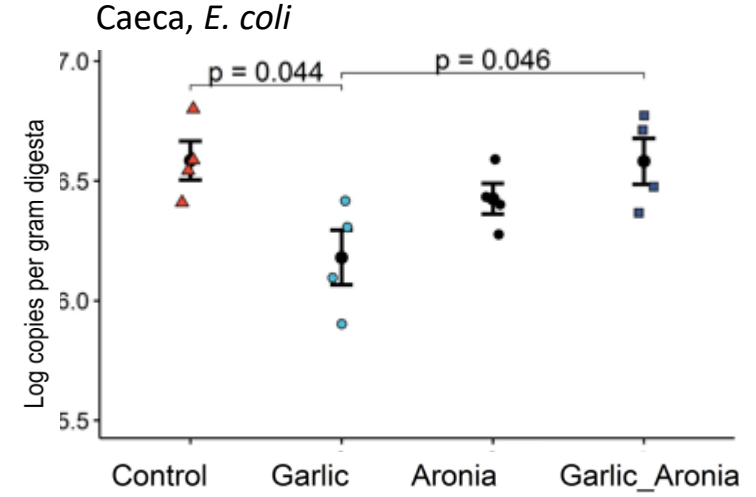
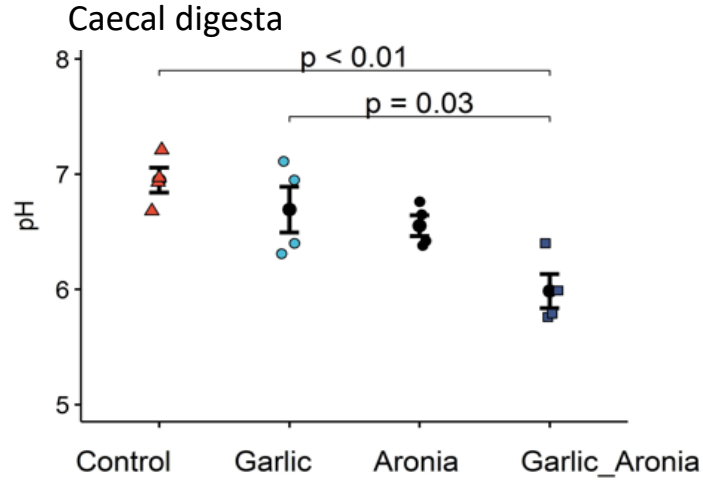
Effect of dietary plant additives

- No effect on performance
- Gut health:
Effect on ileal and caecal contents of organic acids and on the quantity of selected bacteria
- Parasitology:
No effect on *A. galli* EPG, worm burden, or serum *A. galli* specific IgY, EGP for *Capillaria spp.* was lower when hens were supplemented with pumpkin seeds week 7 p.i.
- No effect on immunocompetence

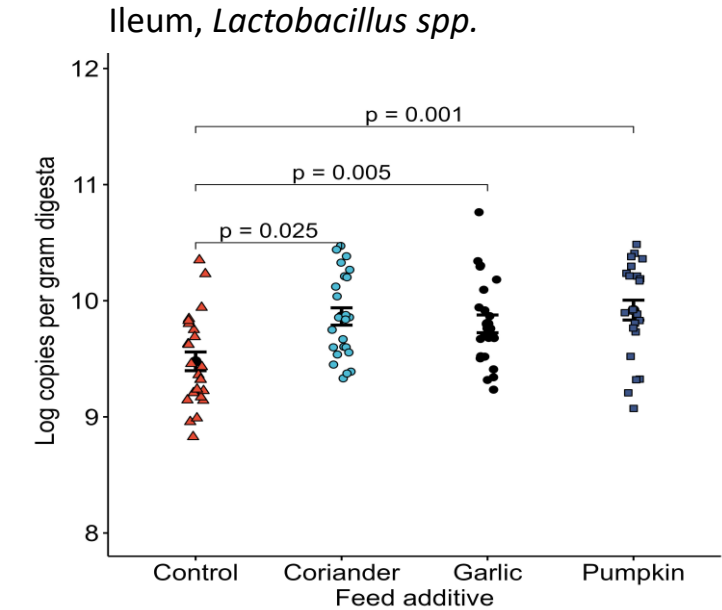
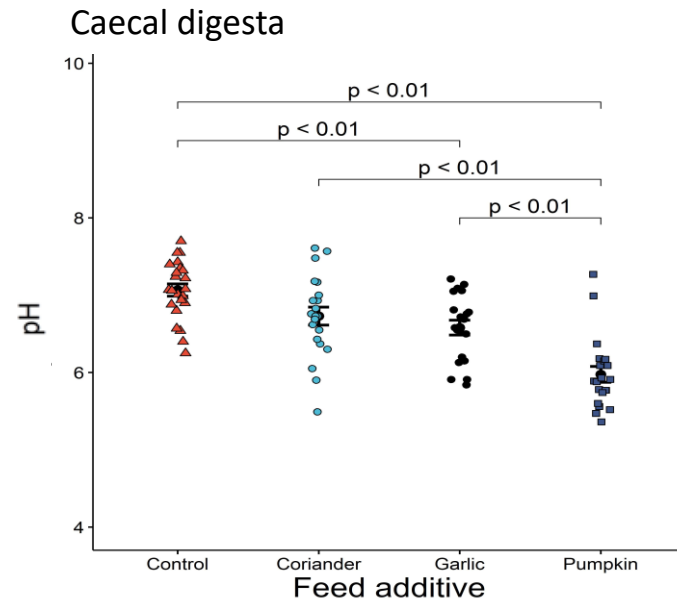


Gut health

Experiment #2
(1% plant supplement)



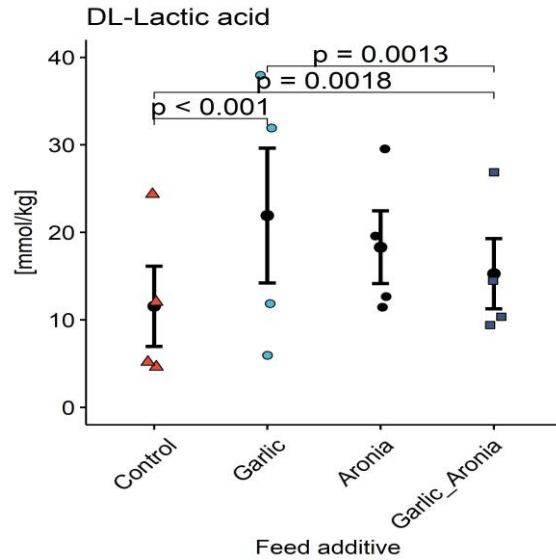
Experiment #3
(2% plant supplement)



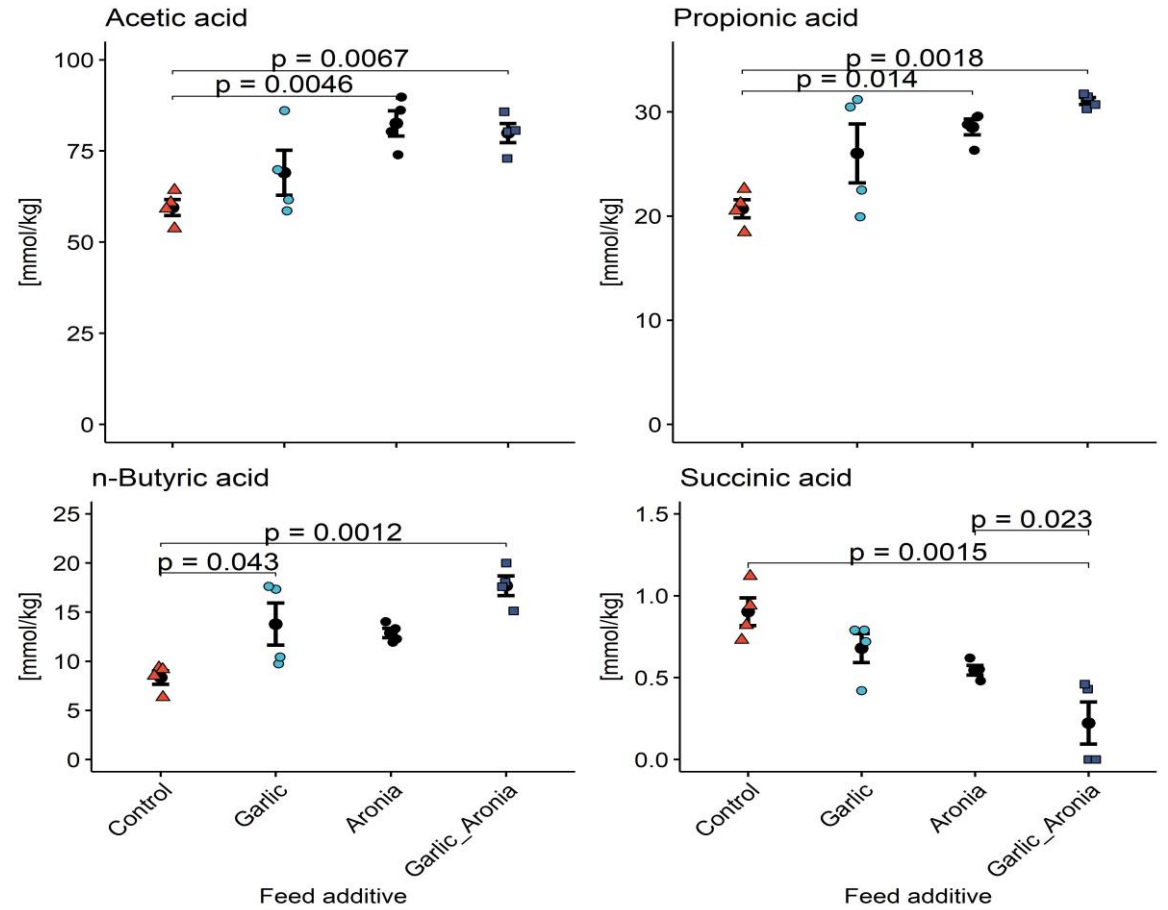
Gut health

Experiment #2
(1% plant supplement)

Organic acids
Ileum



Short chain fatty acids (SCFA)
Caeca



On-farm: Propionic acid treated grain (0.5% propionic acid)

2 different application methods

- Continuously during 9 weeks
- 2 days every 2nd week, three times
- Absence of non-supplemented control group

Disease on the farm egg drop syndrom (virus)

-> No effect of either treatment strategy

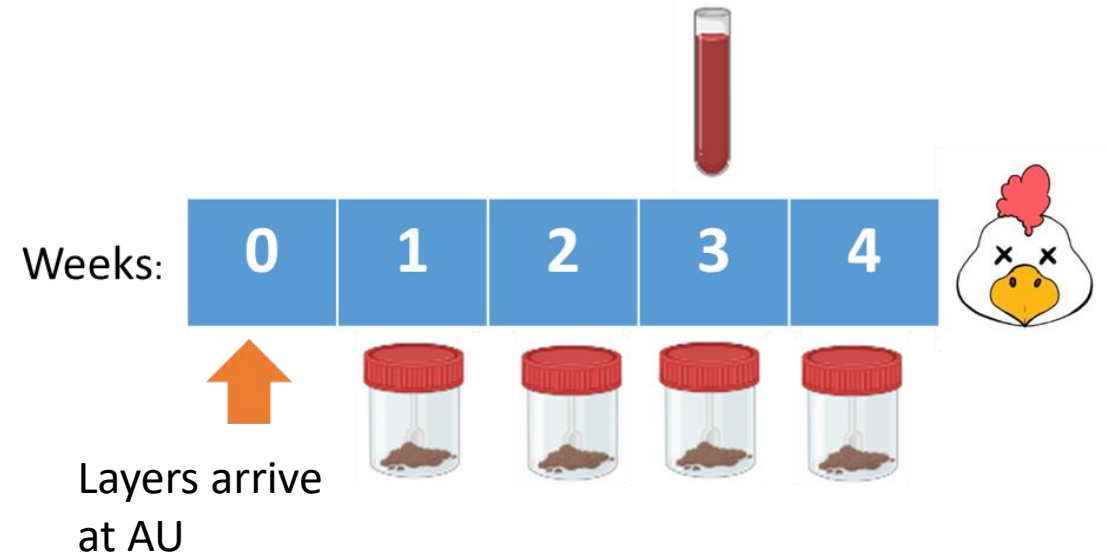
Propionic acid treated grain and pumpkin and coriander oils

48 hens pr. treatment with 6 hens pr. pen (72 hens in total)

Hens were 80 weeks old obtained from an organic egg producer

Hens were naturally infected with nematodes (*A. galli* and *Capillaria spp.*)

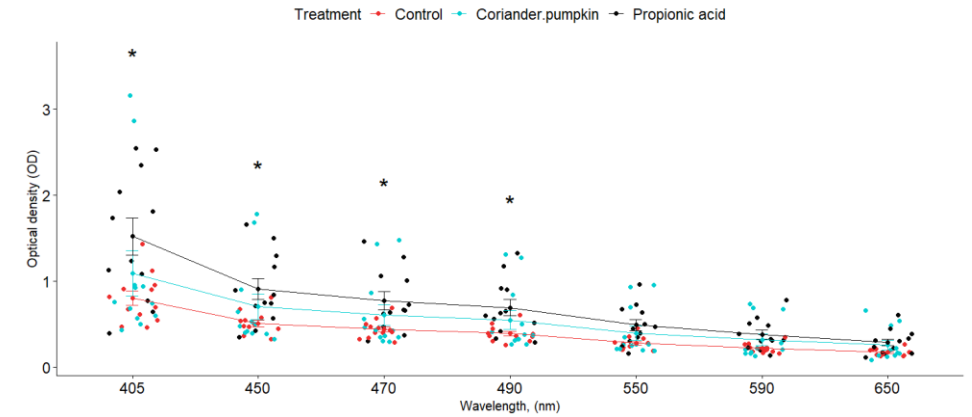
Feed
Grain non-preserved (Control)
Grain + pumpkin seed oil/coriander seed essential oil (50 mg/100g)
Grain preserved with propionic acid (0.5%)



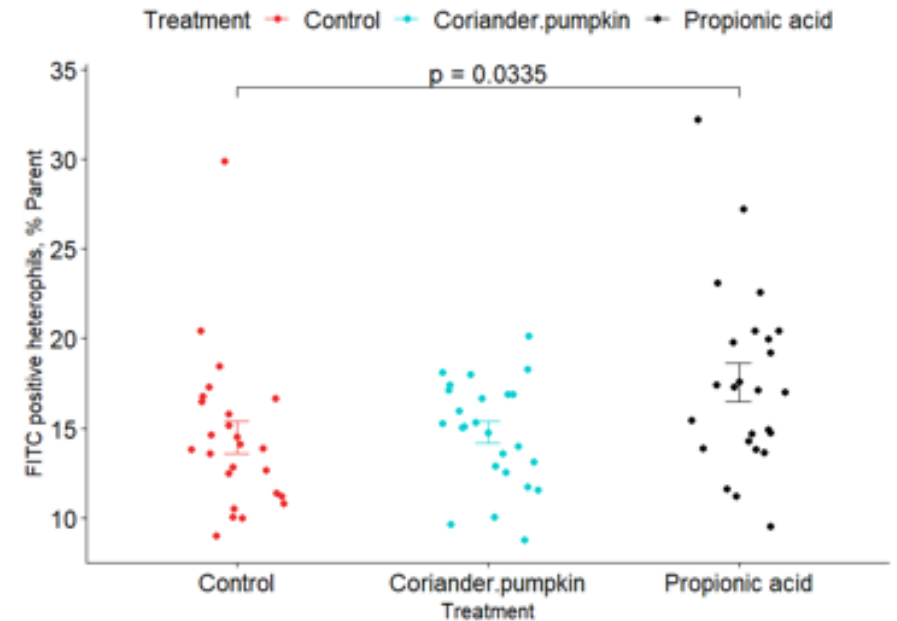
Effect of feed

- No effect on hen performance
- Gut health:
No effect on ileal and caecal contents of organic acids and quantity of selected bacteria
- Plasma coloration values were higher when hens were fed propionic acid treated grain
- Parasitology:
No effect on EPG, worm burden, or serum *A. galli* specific IgY
- Immunocompetence: The phagocytotic activity were higher in isolated heterophils when hens were fed propionic acid treated grain

Plasma coloration



Heterophils



Conclusion

- No firm recommendations can be given with respect to the practical control of *A. galli*
- Ethanolic plant extracts showed good *in vitro* effects, but may not be applicable due to involved costs
- Garlic applied as dried powder at concentrations of 1-2% has the most promising antiparasitic properties
- Most plant additives had beneficial effects on intestinal health
 - Increase of intestinal fermentation
 - Decrease of intestinal pH
 - Decrease of potentially harmful acid sensitive bacteria (*E. coli*)
 - Increase of presumptive beneficial bacteria (*Lactobacillus spp.*)
- Propionic acid at current concentrations does not offer health benefits
 - Reduces gut integrity

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Thank you for your attention

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