

# *Aromatic plants as alternative medicine in animal diets*



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# Overview of the talk

- ☯ Introduction
- ☯ Aromatic plants (herbs), herbal extracts and essential oils as feed supplements
- ☯ Definitions of plant-derived materials and biological effects of aromatic plants (herbs), herbal extracts and essential oils
  - ☯ Anti-microbial activity of herbs and herbal essential oils
  - ☯ Anticoccidial activity of herbs, herbal extracts and essential oils
  - ☯ Antioxidant activity of herbs, herbal extracts and essential oils
- ☯ Use of medicinal plants as alternative medicine
- ☯ Conclusions - future research



# Introduction

## ホ past 50 years:

ホ use of antibiotics as supplementation in animal and poultry feed

ホ improve growth performance and efficiency

ホ protect animals from adverse effects of pathogenic and non-pathogenic enteric microorganisms.

## ホ 2004 ( bacterial resistance → rising consumers concerns):

ホ ban on sub-therapeutic antibiotic usage in European Union countries → ↑↑ interest in finding alternatives to antibiotics for animal production

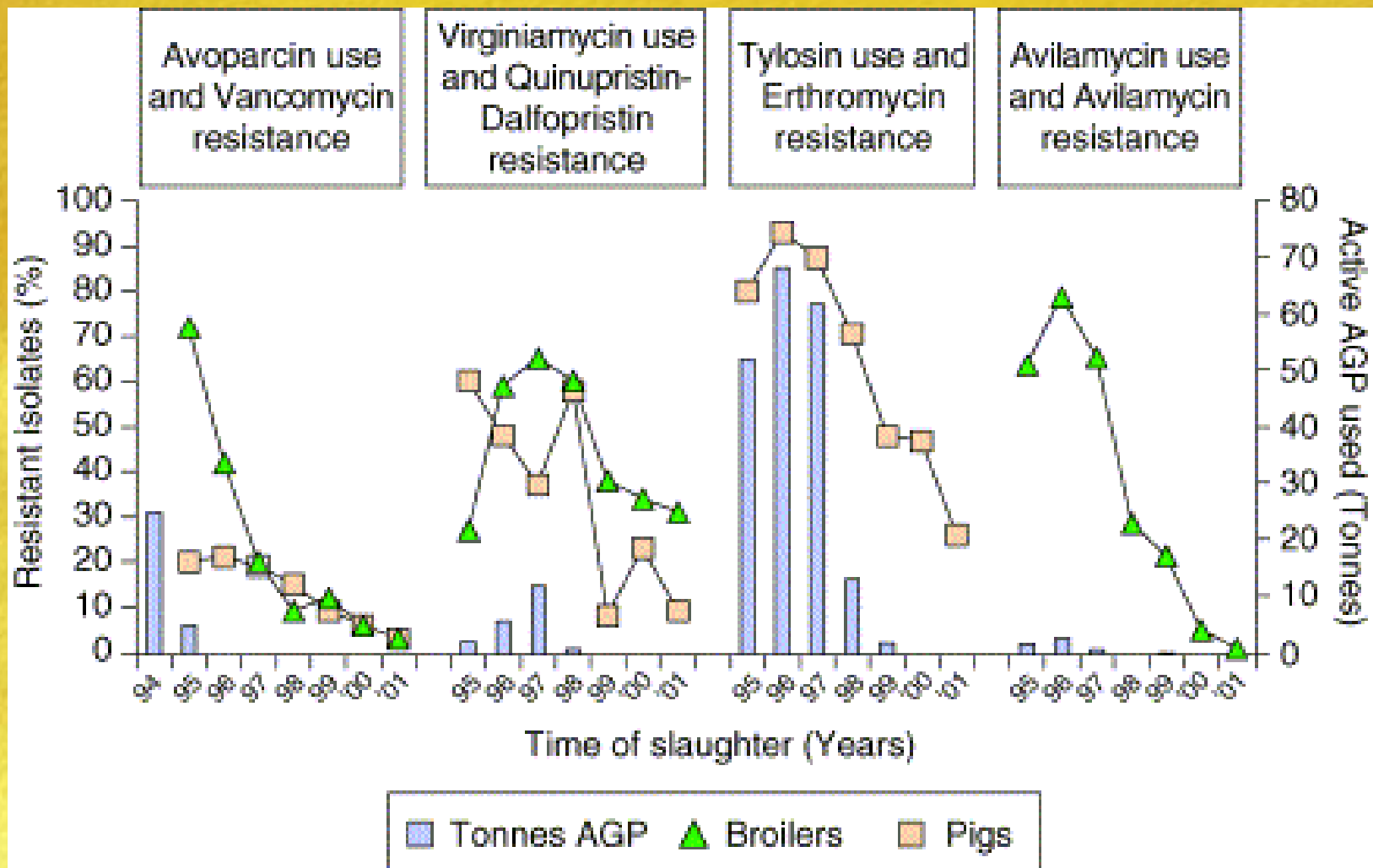
## ホ Therefore:

ホ Need for identification and evaluation of alternatives to traditional antibiotics and ionophore anticoccidials

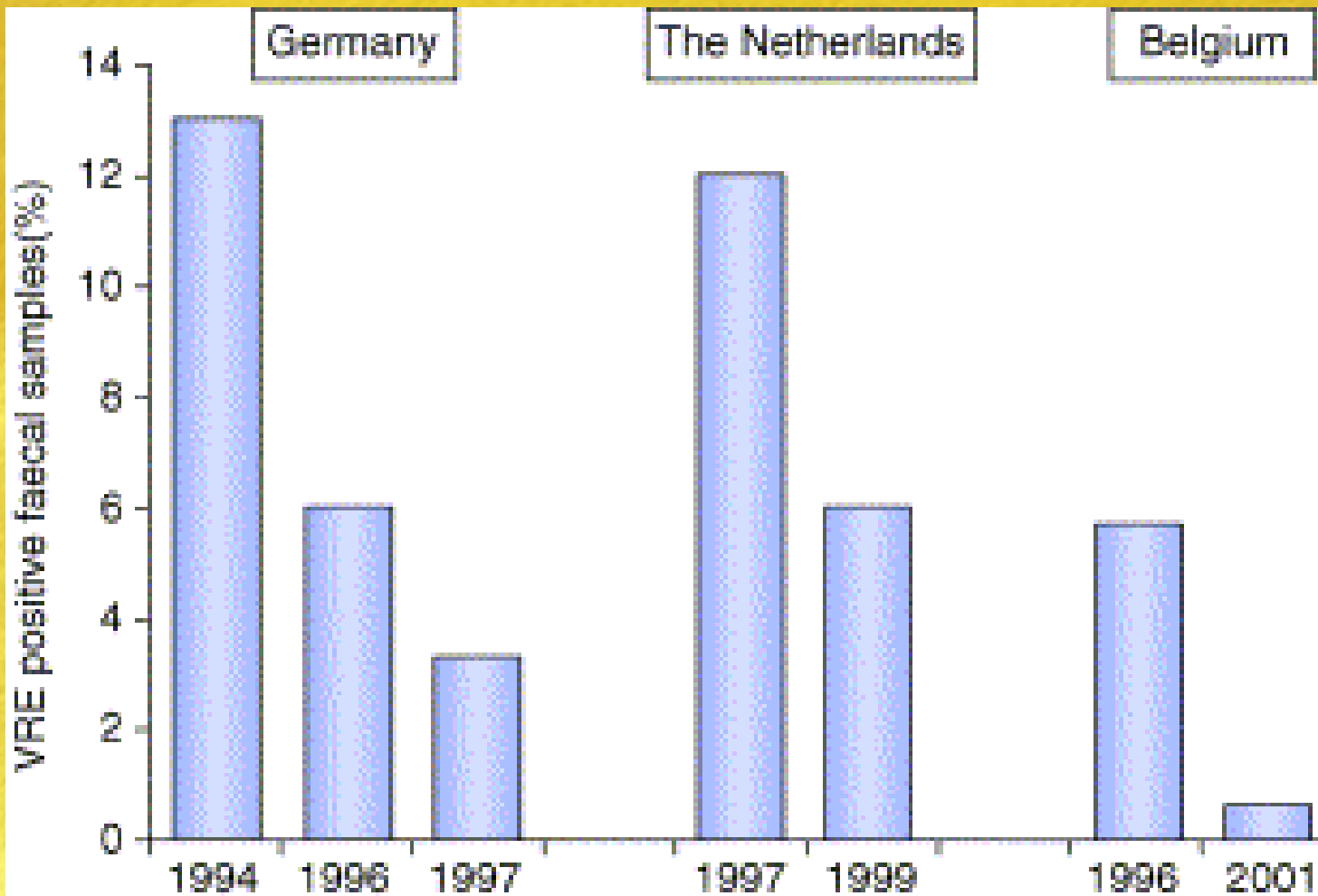
ホ satisfy consumer perceptions and be closer to environmentally friendly farming practices

ホ Introduction of alternative feeding strategies to offset any possible adverse effects on production caused by ban

# Volumes of active AGP used in food-animals in Denmark and prevalence of *Enterococcus faecium* resistant to antibiotics



Vancomycin-resistant *E. faecium* in stool culture samples from healthy humans in Holland and Germany, and in hospitalised patients (Belgium) following the EU prohibition of glycopeptide avoparcin as AGP





# Phytogenic materials as feed supplements-WHY??

キログラム **Aromatic plants and their extracts have been found to exhibit**

キログラム antimicrobial activity

キログラム antiparasitic activity

キログラム antiviral and antioxidative properties

(Botsoglou et al., 2002; Giannenas *et al.*, 2003; Lee *et al.*, 2004)

キログラム **Herbs and their secondary metabolites may:**

キログラム stimulate the endocrine and immune system

キログラム promote a higher metabolic and immune status within the animal

キログラム Enhance animal welfare

キログラム **Various botanical ingredients:**

キログラム facilitate beneficial effects on gut environment and microflora

キログラム stimulate digestive enzymes and may affect lipid metabolism and fat digestibility

# Definition of essential oils, aromatic plants (herbs), and herbal extracts

ぼ Herbs and spices = aromatic plants that might be used in animal feeding after drying and grounding

ぼ Herbal extracts = prepared by different extraction methods with various solvents, such as ethanol, methanol, toluene or other organic solvents

ぼ An **essential oil** = a mixture of fragrant, volatile compounds, named after the aromatic characteristics of plant materials from which they can be isolated

ぼ Term 'essential oil' is a poorly defined concept from medieval pharmacy

ぼ → the term 'volatile oil' proposed to be used instead, however, the term 'essential oil' is used more often



# Biological Effects of aromatic plants, herbal extracts and essential oils:

Are based mainly on Polyphenolic compounds

ぎ found in herbs, spices, their extracts and herbal essential oils, and also in fruits and vegetables

ぎ Over 8,000 polyphenols have been identified and among them more than 2,000 are found in nature

Role of polyphenolic compounds in plants:

ぎ pigmentation,

ぎ growth, reproduction

ぎ resistance to pathogens and fungi and for many other functions





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One of the most important groups of polyphenols are **flavonoids**:

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subgroups: flavones/flavonones, anthocyanins and catechins/flavonols



What are flavonoids?

In plants, flavonoids usually form complexes with various sugars which are called glycosides

Flavones/ flavonones have been isolated from almost all fruits and vegetables with their highest concentrations being found in the outer layers

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**Polyphenols possess:**

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Antimicrobial → targeting against the bacterial cell wall affecting the cell wall structure cell death

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Antifungal

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antiparasitic activity against gastrointestinal parasites

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Similar activity has been exhibited by saponins and condensed tannins and glycosides → study with evidence that condensed tannins have direct anthelmintic effects towards gastrointestinal nematodes of sheep (Athanasiadou *et al.*, 2001)

# Anti-microbial activity of herbs and herbal essential oils

セン  
テ In vitro:

セン  
テ Lee and Ahn (1998) found that cinnamaldehyde, (cinnamon essential oil) selectively inhibits pathogenic, intestinal bacteria → may have a pharmacological role in balancing the intestinal microbiota.

セン  
テ Dorman and Deans (2000) published data of *in-vitro* anti-microbial activities of essential oils derived from

1. Cinnamon
2. Thyme
3. oregano,

supporting their possible use as anti-microbial agents

セン  
テ **Carvacrol, thymol, eugenol, cinnamaldehyde and ionone** (pure components of EO) are known for their anti-microbial activity against selected microorganisms such as species of *Escherichia*, *Candida*, *Salmonella* (Lee *et al.*, 2004)

セン  
テ synergism was highlighted in studies of Didry *et al.* (1994) and Montes-Belmont and Carvajal (1998).



## ✚ In vivo:

✚ On the basis of their *in vitro* antimicrobial activity, it is logical to consider:

✚ essential oils application as prophylactic and therapeutic agents in animal production

✚ It would be expected that the intake of essential oils affects the gastrointestinal microflora composition and population:

✚ Waldenstedt *et al.* (2001) investigated the possibility of rearing broilers without growth promoters and coccidiostats by incorporating in their diet oregano essential oil.

✚ A field study by Köhler (1997) with a commercial preparation of essential oils showed:

✚ a reduction of colony forming units of *C. Perfringens* as compared to the positive control diet containing zinc bacitracin at the level of 20 ppm

✚ A blend of capsicum, cinnamaldehyde and carvacrol lowered the number of *E. coli* and *C. perfringens* in ceca (Jamroz and Kamel, 2002).

# Anticoccidial activity of herbs, herbal extracts and essential oils

大正 Ban of anticoccidial drugs, if established, → strong economic impact on the poultry industry

□ 1997, Allen *et al.*:

□ dried leaves of *Artemisia annua* could protect chickens against caecal lesions due to *E. tenella* infection

□ 2001, Evans *et al.*:

□ a mixture of essential oils from clove, thyme, peppermint and lemon (0.1% - 1%) have effects on coccidia oocyte output and the number of *Clostridium perfringens* in inoculated broiler chicks

□ 2001, Youn and Noh:

□ *Sophora flavescens* extracts were more effective than *Artemisia annua* against *E. tenella* infection in chickens

□ 2003, Giannenas *et al.*:

□ the EO of oregano exhibited coccidiostatic action against *E. tenella* when incorporated into chicken diets at the level of 300 mg/kg

□ 2004, Florou-Paneri *et al.*, 2004:

□ Olympus tea (*Sideritis scardica*) exerted a coccidiostatic effect against *E. tenella*



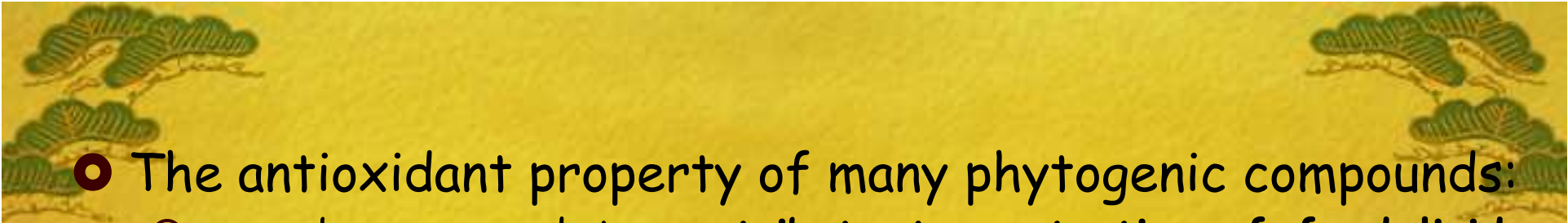

# Antioxidant activity of herbs, herbal extracts and essential oils

In vitro:

**Antioxidative properties are well described for herbs and spices**

Plants with antioxidant activity:

- ☯ Rosemary (rosmarinic acid, rosmarol)
- ☯ Thyme and Oregano ( Thymol, Carvacrol)
- ☯ Ginger & Curcuma
- ☯ Anise & Coriander
- ☯ Green Tea
- ☯ Many fruits
- ☯ Peppers & Chili
- ☯ the active substances often highly odorous or may taste hot or pungent → ↓their use for animal feeding purposes

- 
- The antioxidant property of many phytogetic compounds:
    - ⊙ may be assumed to **contribute to protection of feed lipids from oxidative damage**, such as the antioxidants usually added to diets (e.g.,  $\alpha$ -tocopheryl acetate or butylated hydroxytoluene).
  - This aspect has not been explicitly investigated for piglet and poultry feeds, but:
    - ⊙ Wide practice of successfully using essential oils, especially those from the Labiatae plant family (Thyme & Oregano), as **natural antioxidants** in :
      - ⊙ **human food**
      - ⊙ **feed of companion animals.**
- 



# *Antioxidant property of essential oils as based on animal studies*

- Youdim and Deans (1999):

- ⊙ the effect of thyme oil and its major compound, thymol, as dietary antioxidant supplements on age-related changes in polyunsaturated fatty acids in various organs.
- ⊙ Rats fed the supplements maintained higher levels of polyunsaturated fatty acids, in liver, brain, kidney and heart, than did those fed the control diet

- Conclusion:

- ⊙ Supplement acts as effective free radicals scavengers
- ⊙ influences the in vivo antioxidant defense systems such as superoxide dismutase, glutathione peroxidase and vitamin E

# Use of medicinal plants as alternative medicine

## ● Is it just hocus-pocus??

- ◎ Unlike pharmaceuticals based on a single chemical entity that deals with anomalies in target cells, tissues, or organs, most of the herbal remedies seem to lack scientific foundation and fall more into the realm of myth → WE NEED SOLID SCIENTIFIC EVIDENCE!



# Major challenges:

- ⊙ Plant species must be identified properly
- ⊙ Mode of action, efficacious level of administration and clinical effects of active ingredients must be explained
- ⊙ activity of botanical products can change from year to year due to climatic change and even genetic makeup
- ⊙ The strength of pharmacological effects may vary depending on where the plant was grown, when it was harvested, and how long it was stored

# Our studies with Oregano

- Giannenas *et al.* (2003 & 2005) reported that coccidiostatic action against *E. tenella* was found by
- Oregano essential oil incorporated into chicken diets at the level of 300 mg/kg or oregano dried ground plant at levels of 5.0 & 7.5 g/kg feed
- Challenge of chickens with *E. tenella* was carried out at 14 days of age by oral administration of a 2-ml suspension of  $5 \times 10^4$  sporulated oocysts of *E. tenella*
- Oregano also showed important antioxidant and growth promoting effects [Giannenas I (2004) PhD- The use of oregano in chicken feeding]



# Results of our studies on growth performance

Age	CON	OR5	OR10	OR5- TOC	OR10- TOC	TOC	FLALAS	SEM	P
FCR	1.70 <sup>a</sup>	1.62 <sup>bc</sup>	1.65 <sup>oc</sup>	1.65 <sup>oc</sup>	1.64 <sup>oc</sup>	1.64 <sup>oc</sup>	1.65 <sup>oc</sup>	0.006	0.00
42 D									
WG,g	1,869 <sup>a</sup>	2,119 <sup>bc</sup>	1,979 <sup>oc</sup>	2,109 <sup>bc</sup>	1,999 <sup>oc</sup>	1,944 <sup>oc</sup>	2,089 <sup>bc</sup>	23.4	0.00
FI, g	3,53	3,77	3,64	3,77	3,65	3,53	3,76	39.2	0.51
FCR	1.89 <sup>a</sup>	1.78 <sup>bc</sup>	1.84 <sup>oc</sup>	1.79 <sup>bc</sup>	1.83 <sup>oc</sup>	1.82 <sup>oc</sup>	1.80 <sup>bc</sup>	0.009	0.00

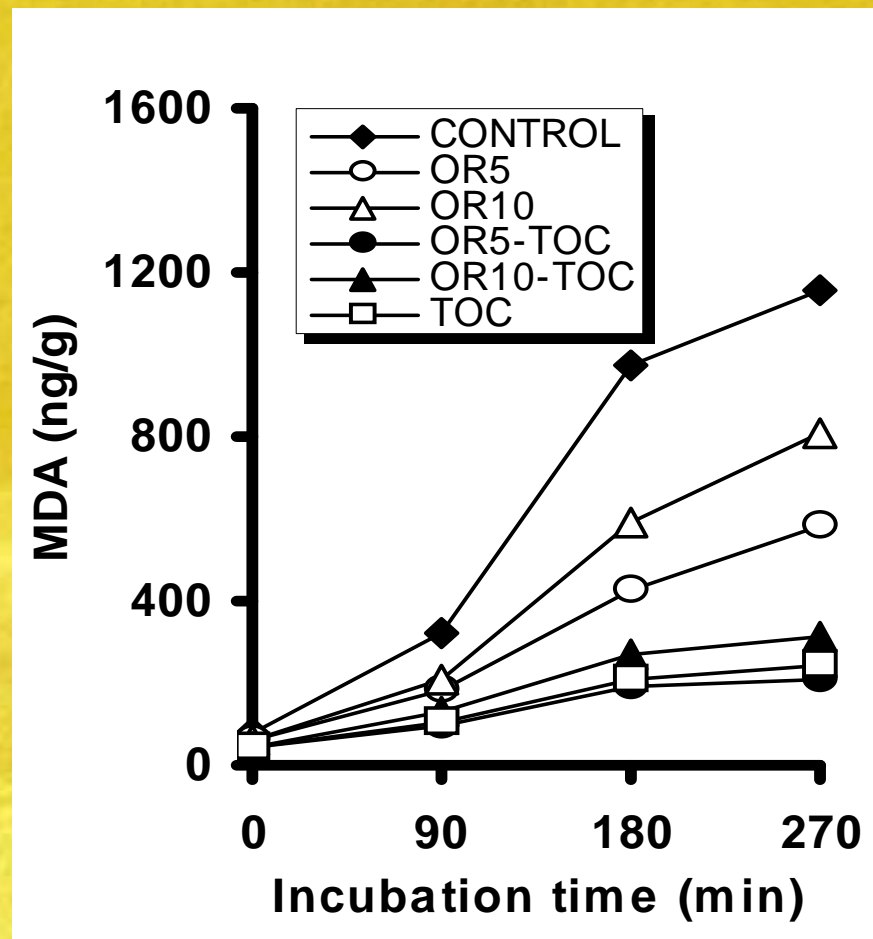
# Results of our studies on coccidia challenge

Dietary treatments	Bloody in total faeces, %					Mortality, % at 21-day of age	Lesion score $\pm$ SD at 21-day of age
	17	18	Age in days		21		
			19	20			
Non-challenged control	0	0	0	0	0	0.0 <sup>a</sup>	0.0 $\pm$ 0.0 <sup>a</sup>
Challenged control	0	<25	51-75	26-50	<25	20.0 $\pm$ 0.0 <sup>b</sup>	3.6 $\pm$ 0.7 <sup>b</sup>
Oregano at 2.5 g/kg diet	0	<25	26-50	<25	<25	10.0 $\pm$ 10.0 <sup>b</sup>	2.7 $\pm$ 1.1 <sup>c</sup>
Oregano at 5.0 g/kg diet	0	<25	26-50	<25	0	6.7 $\pm$ 5.7 <sup>b</sup>	2.4 $\pm$ 1.1 <sup>c</sup>
Oregano at 7.5 g/kg diet	0	<25	26-50	<25	0	6.7 $\pm$ 5.7 <sup>b</sup>	2.5 $\pm$ 1.1 <sup>c</sup>
Oregano at 10.0 g/kg diet	0	<25	26-50	26-50	<25	13.4 $\pm$ 5.7 <sup>b</sup>	2.9 $\pm$ 1.0 <sup>bc</sup>
Lasalocid at 75 mg/kg diet	0	0	<25	0	0	0.0	1.2 $\pm$ 0.6 <sup>d</sup>

Age of chickens (days)	<i>Oocysts counts (x10<sup>3</sup>)/g excreta</i>						
	Non-challenged control	Challenged control	Oregano 2.5 g/kg	Oregano at 5.0 g/kg	Oregano at 7.5 g/kg	Oregano at 10.0 g/kg	Lasalocid 75 mg/kg
21	0	174.2 $\pm$ 1.1 <sup>a</sup>	16.4 $\pm$ 0.8 <sup>b</sup>	36.2 $\pm$ 0.7 <sup>c</sup>	35.8 $\pm$ 0.4 <sup>c</sup>	46.6 $\pm$ 1.2 <sup>d</sup>	11.2 $\pm$ 0.6 <sup>d</sup>



# Results of our studies on antioxidant activity



MDA levels in breast tissue submitted  
to iron-induced lipid oxidation

# Conclusion - Future research

明治 Ban in Europe -  aromatic plants or their extracts as dietary alternative means of controlling animal diseases

明治 →→→ More investigations needed

明治 Consumer expects safe and healthy products -  substitution of conventional medication by natural products

明治 →→→ Development of new therapeutic measurements and (phyto) pharmaceuticals

明治 Progress can be achieved by considering the various aspects of medicinal plants together and thus exploit their complementarity

明治 Emphasis on additional measurements in ongoing research

明治 performance,

明治 immunity

明治 behavioural observations



Thank you for your attention!



Keramoti - Kavala - Thassos





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