



Effects of herbal products *in vitro* and *in vivo*

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Background

Since the ban on antimicrobial growth promoters (AMGPs) in feed there is an increased use of herbal products in feed. The positive effects of AMGPs were commonly thought to be based on their antimicrobial effect. Many herbal products also show profound antimicrobial effects and this may be the reason that they can be used as alternative for AMGPs. But herbal products may exert a range of other physiological effects on the animals that can contribute to their positive effects.

Objective

The aim of the study was to examine the antimicrobial action of herbal feed additives and the relation between this antimicrobial action and performance data *in vivo* and gut histology (villus/crypt ratio) as parameter for gut health.

Introduction

In this study we investigated 5 herbal products for *in vitro* antimicrobial effects and *in vivo* effects on gut health in broiler chickens as compared to an untreated control group. We used both herbal products with a strong antimicrobial action and products with minimal antimicrobial action.

Methods

In vitro antimicrobial effects

For the investigation of antimicrobial action we used both microbroth dilution and agar diffusion tests. Bacteria tested were *Salmonella typhimurium*, *Staphylococcus Aureus Hoechst*, *Pseudomonas aeruginosa*, *Bacillus cereus*, *Escherichia Coli ATCC 11303*, *Escherichia Coli "Bay"* and *Enterococcus faecalis*. The products were tested with and without buffer, because products with a low pH may give growth inhibition which is not related to the herbs.

Animal study

To examine the effects *in vivo* five of these products were fed to broiler chickens which were fed a nutritionally sufficient diet containing a high amount of wheat which may impair digestion and gut health. The products were compared to a control group and the trial was designed as a randomized complete block consisting of six repetitions per treatment. Data on growth, feed intake, and feed conversion ratio were collected and villus crypt ratio was determined as an indication for gut health.

Table 1. Main ingredients herbal products.

Product	Main ingredients
Negative control	none
Biostrong 510 plus	Thyme oil and star anise oil, bitter substances, pungent substances and saponins
Bronch Arom	Anise oil, thyme oil, eucalyptus oil
Allimax	Garlic
Duo Kruidenelixer	120 herbs: a.o. sage, rosemary, thyme, devils claw
PrimeFulvic	Fulvic acid

Results

In vitro antimicrobial effects

It appeared that the herbal products differed in their effects on the micro-organisms, each showing a specific antimicrobial profile (Tables 2 and 3).

Table 2. Microbroth dilution test: the higher the number of the well, the better the antimicrobial action.

	Biostrong 510 plus		Bronch Arom		Allimax		Duo Kruidenelixer		Primefulvic	
	original	buffered	original	buffered	original	buffered	original	buffered	original	buffered
<i>E. Faecalis</i>	8	8	5	1	6	n.d.	2	1	1	1
<i>E. Coli 11303</i>	9	8	5	1	7		1	1	1	1
<i>P. Aeruginosa</i>	4	4	1	1	3		2	1	1	1
<i>E. Coli "Bay"</i>	9	8	12	11	8		2	2	1	1
<i>S. A. Hoëchst</i>	13	12	5	4	7		2	1	1	1
<i>B. Cereus</i>	13	13	6	6	7		2	1	1	1
<i>S. Typhimurium</i>	7	6	4	1	6		2	1	1	2

Table 3. Agar diffusion test: the greater the inhibition zone, the better the antimicrobial action.

	Biostrong 510 plus		Bronch Arom		Allimax		Duo Kruidenelixer		Primefulvic	
	original	buffered	original	buffered	original	buffered	original	buffered	original	buffered
<i>E. Faecalis</i>	30	30	16	14	40	n.d.	20	14	14	14
<i>E. Coli 11303</i>	26	20	24	20	40		28	14	14	14
<i>P. Aeruginosa</i>	14	14	14	14	23		23	14	14	14
<i>E. Coli "Bay"</i>	28	20	24	22	40		25	14	14	14
<i>S. A. Hoëchst</i>	27	23	23	19	40		19	14	14	14
<i>B. Cereus</i>	30	23	24	21	40		26	14	14	14
<i>S. Typhimurium</i>	17	17	19	18	38		19	14	14	14

Animal study

In the broilers there were no significant positive effects of the herbal products, but the highest weight gains were found in the Duo Kruidenelixer group. One group (BronchArom) showed significant higher feed conversion than the controls (Table 4). The histological investigation showed that the Biostrong 510 plus group showed a significantly higher villus crypt ratio than the controls.

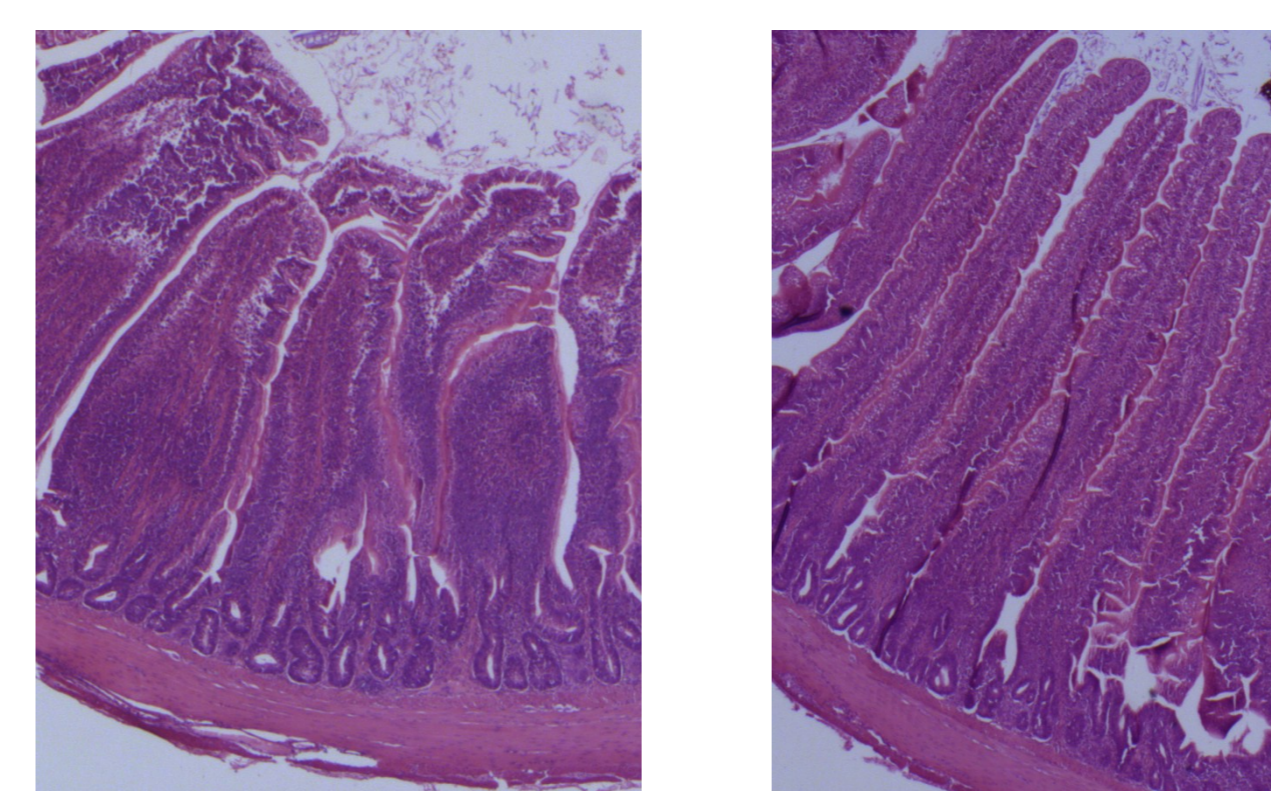


Figure 1. Control animal on the left and Biostrong 510 plus animal on the right showing differences in gut histology of the jejunum.

Table 4. Body weight gain (BWG; g), feed intake (FI; g), and feed conversion ratio (FCR; g/g) from D0-35, as affected by treatment.

Treatment	BWG	FI	FCR
Negative control	2547 ^{ab}	3771	1.481 ^a
Biostrong 510	2528 ^{ab}	3767	1.491 ^{ab}
Bronch Arom	2467 ^a	3734	1.514 ^b
Allimax	2546 ^{ab}	3758	1.476 ^a
DuoKruidenelixer	2615 ^b	3860	1.477 ^a
Primefulvic	2578 ^b	3844	1.490 ^{ab}

^{a,b} Mean values without a common superscript letters within a column differ significantly ($P \leq 0.05$)

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