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Factors Affecting the Incidence of Necrotic Enteritis, Caecal Carriage of *Clostridium perfringens* and Bird Performance in Broiler Chicks

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Elwinger, K., C. Schneitz, E. Berndtson, O. Fossum, B. Teglöf and B. Engstöm: Factors affecting the incidence of necrotic enteritis, caecal carriage of *Clostridium perfringens* and bird performance in broiler chicks. Acta vet. scand. 1992, 33, 369-378. – Two trials were conducted to study the effects of a competitive exclusion (CE) product BROILACT® and the anticoccidial narasin on the incidence of necrotic enteritis (NE), the numbers of *Clostridium perfringens* (CP) in the caeca of broiler chicks and the performance of the birds. In trial 1 the effects of type of protein and partial replacement of a narasin containing diet with whole wheat were also studied.
All groups of chicks were studied up to the point of slaughter at 43 days of age and after evisceration in a processing plant to determine slaughter yield.
In trial 1, statistically significant results included the following: CE-treatment reduced total mortality, and incidence of NE, on diet containing animal but not vegetable protein. Caecal carriage of CP was also reduced, while slaughter yield increased. Narasin reduced caecal carriage of CP and increased both growth rate and slaughter yield in both trials. Whole wheat replacement improved feed conversion but reduced bird growth rate. In trial 2, both CE-treatment and narasin influenced feed intake, CE-treatment significantly only at days 22 and 44. Narasin improved feed conversion until 5 weeks of age and CE-treatment did so until 22 days of age. In both trials, there was also an interaction effect indicating that CE-treatment increased slaughter yield for birds that were not fed narasin.

competitive exclusion; narasin; whole wheat.

Introduction

Necrotic enteritis (NE) is a well known enterotoxemic disease of poultry caused by *Clostridium perfringens* (CP) types A and C. The conditions that lead to the sudden onset of the disease are not fully understood. Disturbances in the normal flora caused by eg stress or coccidial infection predispose the birds to proliferation of the clostridium (*Dykstra & Reid* 1977, *Fukata et al.* 1991). Then, production of α and ß toxins in the small intestine leads to development of serious necrotic lesions in the gut wall, as well as increased mortality and/or liver condemnation at slaughter (*Hutchison & Riddel* 1990, *Onderka et al.* 1990).

Use of competitive exclusion (CE) treatment ("Nurmi concept") is a well known and widely studied method for preventing salmonellosis in chickens and turkeys (*Nurmi & Rantala* 1973, *Mead & Impey* 1987). It is also effective in chicks against CP (*Barnes et al.* 1980, *Snoeyenbos et al.* 1983). However, there is no evidence that the lack of a mature gut microflora is responsible for any disease in the host due to CP (*Mead & Impey* 1987).

NE is normally prevented by the use of dietary growth promoters (*Jansson et al.* 1990). *Kondo* (1988) showed that anticoccidials of the ionophore type, monensin, salinomycin and lasalocid, inhibited growth of CP in vitro. The ionophore used in Sweden today (narasin) appears to be active in this aspect (*Elwinger et al.* 1990, 1992). The action of anticoccidials may also be indirect in supressing coccidial infection by favouring the normal microflora.

Studies involving addition of whole wheat to the feed of chicks from 1 week of age have demonstrated that it may be possible to decrease the feed costs by 0.03-0.16 US$ per chicken (*Elwinger & Teglöf* 1992, *Teglöf* 1990). By this means about 20 % of the original diet will be replaced with wheat. Such a system has been used in Denmark for about 5 years (*Petersen* 1991). However, replacing a part of the anticoccidial containing diet with whole wheat decreases the amount of anticoccidial that the birds receive. The risk of subclinical coccidiosis increases accordingly (*Mörch* 1991).

The main aim of this study was to assess the effects of a commercial CE product, an anticoccidial (narasin), type of protein in the diet, and partial replacement of the diet with whole wheat, separately and in various combinations on the incidence of NE, caecal colonisation by CP and bird performance.

Table 1. Compostion and calculated nutrient content of the experimental diets.

Feedstuffs, g/kg	TRIAL 1 A[4]	TRIAL 1 V[5]	TRIAL 2
Barley	103.7	72.3	200.0
Wheat	460.0	420.0	487.8
Oats	100.0	60.0	100.0
Extracted soybean meal	220.0	230.0	60.0
Rapeseed meal (low glucosinolate)		40.0	50.0
Peas		80.0	
Fish meal	40.0		40.0
Meat and bone meal	20.0		20.0
Animal fat	20.0	20.0	13.0
Acidulated soapstock	10.0	20.0	
Vitamins and trace elements	10.0	10.0	10.0
Salt	1.8	2.8	2.0
Calcium carbonate	9.0	11.0	8.0
Monocalcium phosphate	4.0	12.0	
Dicalcium phosphate			3.0
DL-Methionine	1.2	1.6	1.8
Potatoe protein concentrate[1]		20.0	
L-Lysine-HCl			4.1
Bio-Feed Plus ® [2]	0.3	0.3	0.3
Monteban ® [3]	(0.7)	(0.7)	(0.7)
Calculated nutrient content			
Metabolizable energy, MJ/kg	12.2	12.0	12.0
Protein, g/kg	218.0	216.0	190.0
Lysine, g/kg	11.8	11.8	11.5
Methionine, g/kg	4.9	5.0	4.9
Met + cys, g/kg	8.7	9.1	8.2
Fat, g/kg	53.0	57.0	40.0
Linoleic acid, g/kg	11.2	11.5	10.0
Calcium, g/kg	9.0	9.0	9.0
Phosphorus, g/kg	6.3	6.8	6.0

[1] 850 g/kg crude protein.
[2] Novo A/S, an enzyme complex of carbohydrases.
[3] Narasin, Eli Lilly Co. See Table 2.
[4] Diet with animal protein.
[5] Diet with vegetable protein only.

Materials and methods

Treatment product

The commercial CE product was BROILACT® (Orion Corporation Farmos, Finland), an undefined but limited mixture of chicken intestinal bacteria that is screened to ensure the absence of specific pathogens (*Nurmi et al.* 1987).

Birds

A total of 5400 unsexed Ross broiler chicks was used in each trial. The chicks were delivered on day of hatch from a commercial hatchery situated 300 km from the Research Station.

A batch equivalent to half the total number of chicks was treated with BROILACT® at the hatchery on the morning of the day of hatch. The chicks were treated by droplet application, according to *Schneitz et al.* (1990). Treated and control birds were transported separately in different vans.

Diets

Two basal diets were prepared at the Agricultural University feed mill (Table 1). The diets A and V were used in trial 1. Diet A contained a high proportion of animal protein and diet V only vegetable protein. The diet used in trial 2 contained the same amount of animal protein as diet A. The total protein content was lower mainly due to the amount of soybean meal in the diet. The composition of this diet was comparable with a practical Swedish broiler diet. The diets were prepared both with and without the anticoccidial narasin, at a level of 70 mg/kg. The concentration of the latter was confirmed by analysis, being 66 and 62 mg/kg respectively in trial 1 and 65.4 mg/kg in trial 2.

The diets were steam-pelleted using a 3 mm die. For the first week of rearing the pellets were crushed into smaller particles.

Whole wheat (W) was mixed into the feeds at 100 g/kg beginning when the birds were 7 days of age, at 200 g/kg from day 14 and at 300 g/kg from day 21.

Table 2. Experimental designs.

	TRIAL 1			TRIAL 2		
Category[1]	Basal diet[2]	Narasin	Broilact	Category[1]	Narasin	Broilact
K	A	-	-	K	-	-
K	V	-	-	KC	+	-
K	A	-	+	K	-	+
K	V	-	+	KC	+	+
KC	A	+	-			
KC	V	+	-			
KC	A	+	+			
KC	V	+	+			
KVW	A	+	-			
KCW	V	+	-			
KCW	A	+	+			
KCW	V	+	+			

[1] K = Control
KC = Narasin
KCW = Narasin + whole wheat

[2] A = diet with animal protein
V = diet with vegetable protein only.

Experimental design

The study consisted of 2 trials with 12 and 4 experimental treatments, respectively according to Table 2.

Experimental procedure and recording of data

Each treatment involved 3 replicate floor pens (11 m^2) of 150 birds in trial 1 and 9 in trial 2. The birds were reared on wood shavings. The pens were located in 2 rooms with 12 and 24 pens, respectively. In the first room live weight and accumulated feed intake of the birds were recorded only on the day of slaughter. On arrival at the Research Station the birds given BROILACT® and untreated controls were handled separately and distributed randomly in their respective pens. In order to avoid cross-colonisation the 2 batches of birds were separated from each other by a centre aisle in each room and in maintaining the birds the controls were always dealt with before the BROILACT® groups. Separate implements and shoes were used in control and BROILACT® pens.

The birds in the second room were weighed on a pen basis at the beginning of the experiment, at about 3 and 5 weeks of age and on the day of slaughter. Feed intake and feed conversion ratio (FCR) were calculated for each period. FCR included the weights of those birds that were removed due to mortality, or when used for bacteriological examination.

The dry matter content of the litter was determined on samples taken from the middle of each pen at 5 weeks of age.

In trial 1 one bird per pen was taken randomly from the second room and sacrificed for determination of CP in the caeca at weeks 2, 3, 4, 5 and 6, in total 120 birds. In trial 2 the sampling was performed accordingly to trial 1 except that 1 bird per pen was also taken from room 1 at weeks 5 and 6, in total 144 birds. The birds were killed in the experimental house by cervical dislocation. The caeca were removed immediately using aseptic techniques, transferred to sterile Petri dishes and stored for up to 2h at about +4°C before microbiological examination. A section of 1 caecum with associated content was flamed, transferred to a sterile plastic bag and homogenised with sterile dilution fluid. Determination of CP was carried out according to the Nordic Committee on Food Analyses (*Anon.* 1985) but excluding the use of a sporulation medium for identification. When less than 10 cfu per g were found this was recorded as 5 cfu per g.

For the last 3 days before slaughter all birds were given the diets without narasin. Feeding of whole wheat (trial 1) continued up to the last day.

The birds were slaughtered over 4 days, at the rate of 9 pens per day during days 40 to 43 and 42 to 45 in trial 1 and 2, respectively.

Table 3. Bird production performance.

		TRIAL 1						TRIAL 2			
		Control			Broilact			Control		Broilact	
	Week	K	KC	KCW	K	KC	KCW	K	KC	K	KC
Mortality, %	3a	3.6	3.8	3.7	3.1	2.3	2.4	3.2	3.0	2.9	2.1
	5b	6.4	5.1	4.8	4.4	4.0	3.6	6.0	4.9	5.1	4.1
	6c	6.8	5.7	5.1	5.0	4.4	3.7	7.5	6.4	6.7	5.9
Bird weight, g	3	631	678	649	668	678	647	656	760	725	768
	5	1543	1649	1563	1610	1629	1549	1637	1804	1701	1806
	6	1941	2067	1987	1984	2043	1987	2170	2269	2192	2292
Feed intake, g	3	863	896	887	887	902	880	979	1071	1030	1076
	5	2612	2696	2478	2653	2656	2455	2899	3074	2952	3070
	6	3724	3848	3628	3695	3760	3490	4364	4504	4464	4582
FCR	3	1.37	1.32	1.37	1.33	1.33	1.36	1.46	1.39	1.40	1.38
	5	1.69	1.64	1.59	1.65	1.63	1.58	1.72	1.66	1.68	1.66
	6	1.92	1.86	1.83	1.86	1.84	1.76	1.91	1.93	1.92	1.95
Litter dm, %	5	69.3	70.5	75.2	69.2	68.8	76.2	66.7	72.5	67.0	73.7
Proc. yield, %	6	69.7	70.5	70.7	70.6	70.9	70.3	70.3	72.2	72.3	72.4

a) 21 and 22 days in Expt 1 and Expt 2, respectively.
b) 35 and 36 days in Expt 1 and Expt 2, respectively.
c) 42 and 44 days in Expt 1 and Expt 2, respectively.

This was done at the processing plant of the Research Station. The birds were starved overnight prior to slaughter. Processing yields were recorded by weighing the birds after evisceration and including the neck but not edible offal.

Statistical analyses

For most traits, results were subjected to an analysis of variance based on a 3 × 2 × 2 (trial 1) and 2 × 2 (trial 2) factorial arrangement of variables using the GLM procedure in the Statistical Analyses System (*SAS Institute Inc.* 1985). Using the Contrast statement in trial 1 the effect of the anticoccidial was evaluated comparing experimental treatments KC with K and effect of whole wheat comparing KCW with KC. At slaughter, the data were adjusted to average age in both trials. Relative frequencies for eg mortality and condemnation were angularly transformed before statistical analyses according to *Snedecor & Cochran* (1968). Significant interaction effects were evaluated using the LSD test (*Snedecor & Cochran* 1968).

Results

The results obtained for production performance are given in Table 3 and the corresponding p-values in Table 4. Results influenced by the composition of the basal diet in trial 1 are not shown in any of the tables but will be discussed where necessary. The results at the end of the experiment, adjusted to a bird age of 42 and 44 days in trial 1 and trial 2, respectively, are from all 36 pens in

Table 4. Statistical analyses of bird production performance data. Standard error (S.E.) and the probability (p<) that estimated differences are caused by random effects.

		S. E.		p-values						
				TRIAL 1				TRIAL 2		
	Week	Trial 1	Trial 2	Broilact	KC	KCW	Interaction	Broilact	KC	Interaction
Mortality, %	3	0.9	1.4	0.05	0.88	0.99	0.97	0.14	0.26	0.39
	5	1.2	1.6	0.01	0.91	0.85	0.76	0.12	0.08	0.91
	6	5.1	2.4	0.02	0.76	0.77	0.85	0.37	0.21	0.97
Bird weight, g	3	14	22	0.08	0.02	0.002	0.06	0.001	0.001	0.004
	5	33	26	0.49	0.03	0.001	0.1	0.006	0.001	0.009
	6	29	45	0.71	0.001	0.001	0.05	0.14	0.001	0.96
Feed intake, g	3	23	23	0.43	0.12	0.16	0,42	0,008	0,001	0.03
	5	69	43	0.83	0.40	0.001	0.58	0.20	0.001	0.12
	6	102	88	0.17	0.1	0.001	0.46	0.006	0.001	0.71
FCR	3	0.02	0.02	0.09	0.10	0.001	0.07	0.005	0.001	0.12
	5	0.03	0.03	0.18	0.08	0.005	0.32	0.09	0.002	0.15
	6	0.04	0.03	0.06	0.09	0.008	0.42	0.39	0.03	0.50
Litter dm, %	5	3.6	3.2	0.83	0.83	0.002	0.16	0.51	0.001	0.66
Proc. yield, %	6	0.4	1.1	0.29	0.03	0.46	0.02	0.006	0.02	0.02

Table 5. Weekly distribution of no. of incidents of mortality due to specific causes.

Causes	Trial	Week 1	2	3	4	5	6	Total
Aspergillosis	1	17	5	0	0	2	1	25
	2	0	0	0	0	0	0	0
Ascites	1	0	0	4	13	18	6	41
	2	0	3	3	12	23	42	83
Nephritis	1	30	3	0	0	0	0	33
	2	6	1	0	0	0	0	7
Peritonitis	1	4	0	2	0	1	0	7
	2	21	9	2	0	1	0	33
Acute death syndrome (ADS)	1	1	11	22	14	7	4	59
	2	1	12	16	15	14	14	72
Necrotic enteritis (NE)	1	0	1	1	8	6	0	16
	2	1	0	13	4	1	0	19
Necrotic hepatitis	1	0	0	2	2	1	0	5
	2	0	0	1	0	6	0	7
Arthritis	1	0	0	0	0	0	0	0
	2	1	2	2	6	9	15	35
Leg weakness	1	0	0	2	1	3	0	6
	2	0	0	1	5	10	15	31
Other causes	1	2	0	1	2	1	0	6
	2	17	4	1	3	3	1	29
Negative section	1	10	3	1	2	3	1	20
	2	9	6	3	3	0	3	24
Not examined	1	21	27	0	0	1	13	62
	2	4	1	3	0	4	5	17
Total	1	85	50	35	42	43	21	280
	2	60	38	45	47	71	95	357

both rooms, the other data on performance being based only on birds in the second room (24 pens). All data concerning mortality refer to both rooms (all birds).

The causes of mortality are shown in Table 5. Average mortality proportions of 5.1% and 6.6% were observed for the whole growing period in trials 1 and 2, respectively. BROILACT® significantly decreased mortality in trial 1 ($p<0.02$) which was 6.0 and 4.1 %, respectively for untreated and treated birds. The difference in mortality was most apparent between 2 and 5 weeks of age when NE, ascites and acute death syndrome (ADS) predominated. In trial 2 both BROILACT® and narasin decreased mortality but the differences were not statistically significant. The distribution of NE and necrotic hepatitis as causes of mortality according to experimental treatment are shown in Table 6. In total, 21 and 26 birds developed NE or necrotic hepatitis in trial 1 and 2, respectively, and 18 and 24 birds, respectively, were found in groups given diets without narasin (Table 6). The distribution of mortality in BROILACT® treated and untreated groups was 3 and 18 birds respectively in trial 1 and 9 and 17 respectively in trial 2. However, in

Table 6. Incidence of mortality from cases of necrotic enteritis (NE) plus necrotic hepatitis (NH) and all other causes.

	TRIAL 1						TRIAL 2			
	Control			Broilact			Control		Broilact	
	K	KC	KCW	K	KC	KCW	K	KC	K	KC
NE + NH	16	2	0	2	1	0	15	2	9	0
Other causes	46	52	46	43	39	33	86	84	82	79

trial 1 a significant interactive effect with source of dietary protein ($p<0.02$) indicated that BROILACT® reduced mortality only when the birds were given diet A containing animal protein.

Counts of CP from caecal contents are given in Table 7 and the corresponding statistical analysis in Table 8. Counts of CP from caecal contents were significantly reduced by narasin ($p<0.001$) in both trials. In trial 1 BROILACT® significantly reduced the counts of CP ($p<0.02$). Also there was an almost significant interaction ($p<0.06$) between these factors, indicating a minor effect of BROILACT® if the birds were given diets with narasin. The interactions by age were due to minor differences in ranking order at different ages.

In trial 2 there was no significant effect of BROILACT® on counts of CP ($p<0.09$). The effect of narasin decreased with the age of the birds ($p<0.009$).

In trial 1 growth rate was significantly improved by narasin but impaired by whole wheat. An evaluation of the interactive effect ($p<0.05$ at age 42 days) by the LSD-test

Table 7. Analysis of caecal samples for *Clostridium perfringens*. No. of positive birds out of no. examined and level of carriage ( ) as $\log_{10}$ cfu/g of caecal content:

	TRIAL 1						TRIAL 2			
	Control			Broilact			Control		Broilact	
Week	K	KC	KCW	K	KC	KCW	K	KC	K	KC
2	3/4	0/4	1/4	0/4	0/4	0/4	4/6	0/6	2/6	0/6
	(2.0)	(0.7)	(1.0)	(0.7)	(0.7)	(0.7)	(3.1)	(0.7)	(2.2)	(0.7)
3	4/4	0/4	1/4	0/4	1/4	0/4	5/6	1/6	4/6	0/6
	(4.3)	(0.7)	(1.9)	(0.7)	(1.0)	(0.7)	(6.7)	(0.7)	(4.3)	(0.7)
4	0/4	0/4	0/4	1/4	0/4	0/4	6/6	3/6	5/6	0/6
	(0/7)	(0.7)	(0.7)	(1.7)	(0.7)	(0.7)	(7.9)	(1.7)	(6.0)	(0.7)
5	2/4	0/4	0/4	1/4	0/4	0/4	9/9	5/9	9/9	3)/9
	(2.1)	(0.7)	(0.7)	(1.0)	(0.7)	(0.7)	(5.8)	(2.4)	(6.8)	(2.3)
6	3/4	0/4	1/4	3/4	0/4	0/4	8/9	7/9 [a]	9/9	1/9
	(4.1)	(0.7)	(1.1)	(4.0)	(0.7)	(0.7)	(5.4)	(3.6)	(6.0)	(1.4)
Over	12/20	0/20	3/20	5/20	1/20	0/20	32/36	9/27	29/36	4/36
all	(2.7)	(0.7)	(1.1)	(1.6)	(0.8)	(0.7)	(5.8)	(1.4)	(5.1)	(1.2)

[a] Not included in over all and statistical analyses due to some groups had received the withdrawal diet.

Table 8. Statistical analyses of caecal level of carriage ($\log_{10}$) of *Clostridium perfringens.* Trial 1, n=120, S.E.=1.1; Trial 2, n=108, S.E.=2.0.

		TRIAL 1		TRIAL 2	
Sources of variation		Df	p<	Df	p<
Broilact	(a)	1	0.02	1	0.09
Narasin	(b)	2	0.001	1	0.001
Age	(c)	4	0.002	3	0.001
Interactions					
a x b		2	0.06	1	0.32
a x c		4	0.06	3	0.23
b x c		8	0.001	3	0.009

showed that growth rate of birds not given narasin was improved by BROILACT® and there was a minor effect of narasin on BROILACT® treated birds. Feed intake decreased with the use of whole wheat but was not significantly influenced by narasin or BROILACT®. In trial 2 there were similar significant interactions between BROILACT® and narasin at days 22 and 36. The effect declined with age, however, and at 44 days of age only narasin had significantly influenced the weight of the birds.

Feed intake was not influenced by BROILACT® or narasin in trial 1 but decreased by the use of whole wheat (p<0.001). In trial 2 both BROILACT® and narasin increased feed intake, BROILACT® significantly only at days 22 and 44. A significant interactive effect (p<0.03) at 22 days of age indicated a major influence on birds not given narasin.

FCR was significantly improved by the use of whole wheat in trial 1 and by narasin in trial 2. Narasin numerically improved FCR in trial 1 (p<0.10). In trial 2 BROILACT® significantly improved FCR until 22 days of age (p<0.005), the effect declined with the age of the birds.

The dry matter content of litter was increased by whole wheat (p<0.002) in trial 1 and by narasin in trial 2.

The slaughter yield was increased by the use of narasin (p<0.03) in both trials. In both cases there was also an interactive effect (p<0.02) indicating that BROILACT® increased the yield of birds that were not fed narasin and there was a minor variation in the narasin effect on BROILACT® treated birds.

Discussion

The etiology of NE is not fully known and experimental reproduction of the disease is therefore difficult. Comparisons between experimental and control groups in this study are based on the assumption that except for the treatments each chick did stand an equal chance of developing the disease

The effect of the commercial CE - treatment, BROILACT®, on the health and performance of the chicks was favourable. It reduced numbers of CP in the caeca in both trials as well as total mortality in groups given the animal protein diet in trial 1. In this trial the effect of BROILACT® was most evident during weeks 3 and 4 when NE and ADS were the main causes of mortality. The incidence of NE/necrotic hepatitis and ADS was significantly lower among birds which had been treated with BROILACT®. The effect on occurrence of NE is thought to be correlated with the effect on CP. The relationship between ADS and the composition of the intestinal microflora is uncertain, but the effect may be indirect. In trial 2 BROILACT® also reduced mortality, but not significantly. ADS was evenly distributed over experimental treatments, the main differences occurring in NE (Table 5) and leg diseases with 47 and 19 cases in untreated and treated groups, respectively.

Differences in response to CE between the trials may have been due to many factors including the condition of the newly-hatched chicks, their immune status, the infection pressure and the diet.

In both trials the beneficial effect of BROILACT® was also seen in the increased growth rate of non-medicated birds during the early stage of rearing.

Furthermore, BROILACT® treatment increased the slaughter yield of non-medicated birds but, again, this effect is most likely to have been indirect.

The use of narasin was also beneficial. It reduced numbers of CP, and incidence of NE, increased bird growth rate and thus, probably, the slaughter yield. Narasin has an antibacterial effect in the intestines which has also been shown in previous studies (*Elwinger et al.* 1990, 1992). *Guneratne & Gard* (1991) suggested that the improved weight gain caused by narasin could be due to the anticoccidial activity of the drug. In our study, however, coccidia were not demonstrated in any of the birds. We suggest, therefore, that the growth promoting effect is more likely to be due to the antibacterial effect.

The partial replacement of the commercial diet by whole wheat improved the FCR after 3 weeks of age but reduced growth rate. The advantage of the former tends to be offset by the latter. In this case the dry matter content of the litter increased which may reduce the risk of coccidial infection.

These trials demonstrate the antibacterial and growth promoting effects of narasin on broilers fed diets without usual growth promoters. The use of BROILACT® also decreased the number of CP in caeca and bird weight was higher in BROILACT® treated groups given diets without narasin compared to untreated controls without narasin.

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Sammanfattning

Factorer som inverkar på förekomsten av nekrotisk enterit, Clostridium perfringens i blindtarmarna och produktionsresultat hos slaktkycklingar.

I 2 försök duschades nykläckta slaktkycklingar med en bakteriekultur bestående av en normal bakterieflora från vuxna höns (BROILACT®). Syftet var att studera effekten av s k "competitive exclusion" på *Clostridium perfringens* (CP) i blindtarmarna och förekomsten av nekrotisk enterit (NE) samt kycklingarnas produktionsresultat. Samtidigt prövades effekten av ett koccidiostatikum (narasin), och i försök 1 också effekten av foder med olika proteinkällor samt effekten av att tillsätta hel vete till foderblandningar med narasin.
I försök 1 bestod vart och ett av de 12 försöksleden av 3 grupper á 150 kycklingar. I försök 2 med 4 försöksled fanns 9 sådana upprepningar. Försöken pågick i ca 6 veckor och med slakt.
I båda försöken gav narasin lägre innehåll av CP, lägre frekvens av NE, bättre tillväxt och högre slaktutbyte. I försök 1 hade Broilactbehandlade kycklingar lägre dödlighet och lägre frekvens av NE då de fick ett foder med animaliskt protein. Broilactkycklingar hade också lägre antal av CP i blindtarmarna i jämförelse med obehandlade kycklingar som inte fått narasin. Hel vete förbättrade foderutnyttjandet men sänkte tillväxthastigheten. I försök 2 gav både narasin och BROILACT® högre foderintag. Narasin gav lägre foderkvot upp till 5 veckors ålder medan förhållandet var omvänt vid slakt efter tillbakahållningsperioden. I båda försöken fanns också ett signifikant samspel mellan narasin och BROILACT® avseende slaktutbyte. Kycklingar som vare sig behandlats med BROILACT® eller fått foder med narasin hade lägre slaktutbyte än övriga.

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