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REDUCTION OF ECONOMIC LOSSES CAUSED BY MYCOPLASMAL PNEUMONIA OF PIGS BY VACCINATION WITH RESPISURE AND BY TIAMUTIN TREATMENT

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The possibilities and economic benefits of controlling mycoplasmal pneumonia of pigs caused by *Mycoplasma hyopneumoniae* by immunisation with Respisure and by Tiamutin treatment were studied. The experiment was carried out in a herd comprising 1000 sows which was free of PRRS, Aujeszky's disease, swine dysentery and leptospirosis, and the prevalence of mycoplasmal pneumonia was low because the farm had recently been restocked. Groups C1 and C2 served as untreated controls, while Groups R1 and R2 received a prestarter diet containing 100 ppm Tiamutin from the time of weaning. Piglets of Group R1 were vaccinated with Respisure vaccine once on day 69, while those of Group R2 twice, on days 65 and 80. Piglets of Groups ST1 and ST2 were fed 100 ppm Tiamutin in the diet for 7 days at the time of weaning and then at 4 months of age, while pigs of Group ST2 received such treatment also in the 6th month of life. The efficacy of treatment was analysed on the basis of the number of animals that died, were emergency slaughtered or were retarded in growth in the different groups, the body weight of animals at weaning, at 94 and 148 days of age and at the time of slaughter, their daily body weight gain, the lung lesions found in animals slaughtered from the different groups, the costs of medication and vaccination, and the cost-benefit calculations of the results. The mortality and emergency slaughter rate was 2.88% and 4.62% in Groups ST2 and ST1, respectively, 4.23% and 4.62% in Groups R2 and R1, respectively, and 8.39% and 9.44% in the control groups (C2 and C1, respectively). The rate of growth retardation was 0.48% and 2.12% in Groups R1 and R2, respectively, 1.59% and 3.46% in Groups ST1 and ST2, respectively, as compared to 8.03% and 6.55% in the control groups (C1 and C2, respectively). The severity score of lung lesions was 1.82 and 1.46 in Groups R1 and R2, 2.18 and 2.93 in Groups ST1 and ST2, and 3.83 and 4.02 in the control groups C1 and C2, respectively. The mean finishing weight of pigs was 102.4–107.8 kg and 95.2–106.6 kg in the treated groups and 94.5–98.6 kg in the control groups. The classification of pigs according to the EUROP categories showed a shift to the E and U categories in the treated groups. The average feed cost per one

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kg of liveweight was 77.89–82.64 Forints in the treated groups and 85.66 Forints in the control groups.

Key words: Mycoplasmal pneumonia, *Mycoplasma hyopneumoniae*, medication, Tiamutin, Respisure vaccination, economic benefit

Mycoplasmal pneumonia causes substantial economic losses to pig production. The disease has been known to occur in Hungary already since the beginning of the 20th century and its presence was confirmed by pathological studies in 1975, when the causative agent, *Mycoplasma hyopneumoniae (suipneumoniae)* was isolated (Stipkovits et al., 1975). That mycoplasma adheres to epithelial cells of the respiratory tract (Zelinski et al., 1990; Debey and Ross, 1994; Utrera et al., 2002) and, by its metabolic products and through the induction of tumour necrosis factor (Geary and Walczak, 1985; Thacker et al., 1999), it causes marked cell damage and suppression of the immune system (Kishima and Ross, 1985; Wannenmühler et al., 1988; Messier et al., 1991; Thacker and Thacker, 1998). Thus, it makes the infected animals susceptible to adverse effects of the environment as well as to various viral infections such as PRRS and swine influenza (Thacker et al., 1999) and bacterial pathogens including *Pasteurella multocida, Actinobacillus pleuropneumoniae* and cilia-associated respiratory bacillus (CAR-bacillus) (Ciprian et al., 1988; Caruso and Ross, 1990; Andrada et al., 2002). Such secondary infections result in further aggravation of the pathological process initiated by mycoplasmas. This will lead to reduced growth rate, decreased daily body weight gain, increased rate of mortality and emergency slaughter, and impaired feed conversion rate. According to the results of an extensive survey conducted in the United States, the extent of gross pathological lesions typical of mycoplasmal pneumonia is in direct proportion to the decrease of body weight gain and deterioration of the feed conversion rate. Lesions extending to 10% of the lungs result in 37.4 g lower daily body weight gain as compared to pigs having lungs free of pathological changes (Straw et al., 1989).

There are two basic methods for reducing the economic losses due to mycoplasmal pneumonia: the use of antibiotics (Stipkovits et al., 1979; Mészáros et al., 1985), and vaccination (Thacker and Thacker, 1998, 2000; Thacker et al., 2000). Of the antibiotics, primarily macrolides are recommended for this purpose. Favourable experience has been obtained by the use of Tiamutin for the treatment of swine pneumonia and in eradication programmes of *M. hyopneumoniae* in Hungary (Stipkovits et al., 1977; Mészáros et al., 1985). At present five vaccines are available on the Hungarian market for immunisation against mycoplasmal pneumonia: Respisure (Pfizer), Hyoresp (Merial), Suvaxyn hyo (Fort Dodge Laboratories), Porcillis hyo (Intervet), and Respisure1One (Pfizer). In the trial reported in this paper, Tiamutin and Respisure vaccine were used for reducing the losses caused by the disease. The objective of the present experiment was not to compare the efficacy of vaccination and Tiamutin treatment but to demonstrate that pig herds infected by *M. hyopneumoniae* had to be treated in order to improve the production indices.

Materials and methods

Experimental herd

The experiment was carried out in a herd comprising 1000 sows and their progeny. The farm had been built in 1981 and comprised buildings of Mezőpanel structure. The breeding part of the farm consists of two farrowing houses with 7 rooms each. The house contains 126 farrowing pens. Piglets are weaned at 30 days of age.

The breeding flock is housed in separate buildings. Artificial insemination is used. The breeding pigs are fed a ration with swill. Manure is treated according to the slurry management system.

Fattening is done in a three-phase system in separate houses. Each phase lasts 50–60 days. The pigs kept on slatted floor are fed from combined self-feeders in the first two phases. Drinking water is provided from nipple drinkers.

In the finishing phase of fattening (over 140 days of age) the pigs are kept on solid concrete floor, fed a ration complemented with kitchen swill and provided with drinking water from cup drinkers. This phase has a slurry management system; the generated slurry is separated into phases and then stored in sedimentation basins.

The farm breeds pigs of the KA-HYB line. During fattening, the pigs received a ration consisting of 38% maize, 27% wheat, 15% barley and 20% concentrate and containing 13.8 MJ/kg NE and 13.66% digestible crude protein. The feed was transported to the farm in 30-kg bags. Feed consumption was recorded and feed leftovers were weighed at the end of the experiment.

The farm had been restocked two years before the start of the experiment. The management and feeding conditions were acceptable. The herd was free from swine dysentery, Aujeszky's disease, PRRS and circovirus infection. The lungs of finishers initially showed a favourable picture.

Before the experiment the herd showed typical clinical signs of mycoplasmal pneumonia. Coughing and growth retardation were observed among the fattening pigs, and by the end of the fattening period the severity of these signs increased.

Microbiological examination

The mycoplasmal aetiology of pneumonia was confirmed by laboratory examinations. Isolation of mycoplasmas was attempted from 10 lung samples taken from the farm, using Friis medium (Friis, 1975). *Mycoplasma hyopneumoniae* was isolated in six cases. The isolates gave specific reaction by PCR (Artiushin et al., 1993). *Pasteurella multocida* was isolated in three cases. *Actinobacillus pleuropneumoniae* infection could not be demonstrated in the herd either by culturing or by serological tests. Seventy-five percent of the 100 serum samples taken from the herd contained antibodies to *M. hyopneumoniae* (Sörensen et al., 1992). The herd was free from Aujeszky's disease virus, PRRS, circovirus and swine influenza virus infection.

Treatment

After transfer to the farrowing house, all sows included in the experiment received a feed containing 100 ppm Tiamutin (Novartis AH, Basle, Switzerland) for 10 days. Sows transferred to the same room farrowed within three days, while piglets assigned to a given treatment group were born within a maximum of 10 days. According to the practice typical of the farm, piglets kept in the same room were treated at the same time, between 6 and 8 days of age, with 0.5 ml and then between 14 and 18 days of age with 1.0 ml 10% oily Tiamutin injection (Novartis AH, Basle, Switzerland). Subsequently, three experimental groups were formed. The number of pigs included in the different groups is shown in Table 1. In the trial, two successive series of experiments were carried out. The piglets were weaned at 30 days of age. In the first series the different groups received the following treatment:

Group C1: The animals were left as untreated controls.

Group R1: After weaning the piglets were fed a starter diet containing 100 ppm Tiamutin, then they were vaccinated with Respisure vaccine (Pfizer AH) once at the average age of 69 days. The vaccine is an Amphygen-adjuvanted formulation of mycoplasma bacterin patented by Pfizer.

Group ST1: After weaning the piglets were fed a starter diet containing 100 ppm Tiamutin, then at an average age of 120 days they received a diet containing 100 ppm Tiamutin for a period of 7 days each.

In the second series of experiments the different groups received the following treatments:

Group C2: The animals received the same treatment as those of Group C1.

Group R2: After weaning the piglets were fed a starter diet containing 100 ppm Tiamutin, then they were immunised with Respisure vaccine twice, at an average age of 65 and 80 days.

Group ST2: The piglets were fed a starter diet containing 100 ppm Tiamutin, then at an average age of 120 and 180 days they received a diet containing 100 ppm Tiamutin for a period of 7 days each.

The efficacy of treatment was evaluated by monitoring the following parameters.

(1) The number of animals that died or were emergency slaughtered in the different groups were recorded and compared by the chi-squared test.

(2) The animals were weighed, two pigs at a time, at weaning, at an average age of 90 and 140 days, and then at the time of slaughtering. The average body weights measured in the different groups were analysed by Student's *t*-test.

(3) The administered feed was recorded daily in each group, daily body weight gain was calculated for all groups, and the average body weight gain of the groups was compared by Student's *t*-test.

(4) Pigs slaughtered from the different groups were regularly checked for lung lesions. Before and after the start of treatment, the lungs of pigs transported from the fattening house to the slaughterhouse were examined for lesions typical of pneumonia. The lesions were scored as follows: negative findings: 0, changes involving less than 50% of the surface of lung lobes: 1, pneumonic lesions involving more than 50% of the surface of lung lobes: 2. The maximum score was 14 per animal. The scores recorded in the treated groups were analysed by the chi-squared test.

(5) By taking into account the costs of the antibiotic and the vaccine, the effectiveness of the different treatments was determined by cost-benefit calculations.

Results

In the first series of experiments, the different experimental groups included 498–628 pigs (Table 1). In the first series of experiments, the vaccinated and Tiamutin-treated groups showed a significantly ($P < 0.01$) decreased mortality and emergency slaughter rate (4.62% and 5.14% for Groups ST1 and R1, respectively) as compared to the control group (9.44%). The difference between the vaccinated and the medicated group was not statistically significant. Similarly, the percentage of animals showing growth retardation (i.e. of those failing to reach the finishing weight) markedly decreased in the treated groups (0.48% and 1.59% for Groups R1 and ST1, respectively) as compared to the control group (8.03%) (Table 1).

In the second series of experiments, a similar tendency could be observed as regards the difference between the treated and the control groups. The mortality and emergency slaughter rate in the treated groups was 2.88% and 4.23% for Groups ST2 and R2, respectively, whereas the percentage of animals showing growth retardation was 2.12% and 3.46% for Groups R2 and ST2, respectively. These parameters were significantly higher in the control group (mortality + emergency slaughter 8.39%, growth retardation 6.55%).

Table 1

Number of pigs that died or were emergency slaughtered and those showing growth retardation in the different groups

Groups		No. of pigs	Mortality + emergency slaughter		Growth retardation	
Treatment 1						
C1	n	498	47	(9.44%)	40	(8.03%)
	χ^2 test		C1–R1	P < 0.01	C1–R1	P < 0.001
			C1–ST1	P < 0.01	C1–ST1	P < 0.001
R1	n	623	32	(5.14%)	3	(0.48%)
	χ^2 test		R1–ST1	NS	R1–ST1	P < 0.05
ST1	n	628	29	(4.62%)	10	(1.59%)
Treatment 2						
C2	n	595	43	(8.39%)	39	(6.55%)
	χ^2 test		C2–R2	P < 0.05	C2–R2	P < 0.01
			C2–ST2	P < 0.01	C2–ST2	P < 0.05
R2	n	520	22	(4.23%)	6	(2.12%)
	χ^2 test		R2–ST2	NS	R2–ST2	P < 0.05
ST2	n	520	15	(2.88%)	18	(3.46%)

The prevalence of pneumonic lesions in animals sent to the slaughterhouse from the different groups and the scores indicating the severity of pneumonia are presented in Table 2. The number of animals with pneumonic lesions showed a statistically significant decrease (by approx. 10–35%) in the treated groups in both series of experiments. Parallel to that, the score indicating the severity of pneumonia expressly decreased. Also in this regard, the vaccinated groups showed better results than the medicated group. The treatment markedly reduced the incidence of pneumonia as compared to the period before treatment, when 99–100% of pigs sent to the slaughterhouse had pneumonia and the pneumonia severity score ranged from 3.04 to 6.17 (Table 3). Comparison of the lung lesion scores of pig groups slaughtered before the treatment period revealed significantly lower lung lesion scores than in pigs slaughtered in the autumn.

The average body weights of the groups included in the first series of experiments, measured at different times, are presented in Table 4. At weaning there were no significant differences between the groups in average body weight. On day 98 and especially on day 149, the average body weights measured in the control group tended to be lower than those measured in the vaccinated or Tiamutin-treated groups. At slaughter only the vaccinated group had higher average body weight. As regards the average daily body weight gain, no difference could be observed between the groups at weaning; on the other hand, on days 98 and 149 and at the time of slaughter the treated groups showed higher daily body weight gain as compared to the control group. No difference could be found in average daily gain between the vaccinated and the Tiamutin-treated group (Table 5).

Table 2

Prevalence of pneumonia in the experimental groups

Groups		No. of pigs	Lung lesions		Severity score		Mean severity score
Treatment 1							
C1	n	106	103	97.17%	405		3.83
	χ^2 test		C1–R1	P < 0.001	C1–R1	P < 0.001	
			C1–ST1	P < 0.001	C1–ST1	P < 0.001	
R1	n	98	63	64.29%	179		1.82
	χ^2 test		R1–ST1	NS	R1–ST1	P < 0.05	
ST1	n	119	88	79.95%	259		2.18
	χ^2 test						
Treatment 2							
C2	n	99	98	98.99%	398		4.02
	χ^2 test		C2–R2	P < 0.001	C2–R2	P < 0.001	
			C2–ST2	P < 0.001	C2–ST2	P < 0.001	
R2	n	239	174	72.80%	349		1.46
	χ^2 test		R2–ST2	P < 0.001	R2–ST2	P<0.001	
ST2	n	120	107	89.19%	352		2.93

Table 3

Prevalence of pneumonia before vaccination and antibiotic treatment

Date			No. of pigs	Lung lesions		Severity score		Mean severity score
20.03.1995	A	n	98	97		295		3.04
04.09.1995	B	n	98	98		605		6.17
25.09.1995	C	n	98	98		545		5.56
27.11.1995	D	n	99	99		493		4.98
19.02.1996	F	n	113	113		360		3.19
χ^2 test				A–B	NS	A–B	0.001	
				A–C	NS	A–C	0.001	
				A–D	NS	A–D	0.001	
				A–F	NS	A–F	NS	
				B–C	NS	B–C	0.05	
				B–D	NS	B–D	0.001	
				B–F	NS	B–F	0.001	
				C–D	NS	C–D	0.05	
				C–F	NS	C–F	0.001	
				D–F	NS	D–F	0.001	

Table 4

Body weight of pigs in the first experiment

Time	Statistics	C1	R1	ST1
Weaning	Litter size	54	64	65
	Kg	9.82 ± 1.2	9.78 ± 0.99	10.17 ± 0.98
	χ^2 test	C1–R1 NS	R1–ST1 NS	–
		C1–ST1 NS		
90 days	n	80	80	56
	Kg	36.12 ± 4.89	40.49 ± 4.55	39.90 ± 2.86
	χ^2 test	C1–R1 P < 0.001	R1–ST1 NS	–
		C1–ST1 P < 0.001		
140 days	n	80	104	108
	Kg	66.77 ± 8.04	69.19 ± 6.94	70.02 ± 9.23
	χ^2 test	C1–R1 NS	R1–ST1 NS	–
		C1–ST1 P < 0.05		
Slaughter	n	106	98	119
	Kg	98.59 ± 20.78	102.43 ± 19.58	95.29 ± 11.64
	χ^2 test	C1–R1 NS	R1–ST1	–
		C1–ST1 NS		

NS = non-significant

Table 5

Daily body weight gain of pigs in the first experiment

Time	Statistics	C1	R1	ST1
Weaning	n	498	623	628
	Kg	0.295 ± 0.0320	0.295 ± 0.031	0.301 ± 0.047
	χ^2 test	C1–R1 NS	R1–ST1 NS	–
		C1–ST1 NS		
90 days	n	80	80	56
	Kg	0.372 ± 0.05	0.405 ± 0.046	0.411 ± 0.030
	χ^2 test	C1–R1 P < 0.001	R1–ST1 NS	–
		C1–ST1 P < 0.01		
140 days	n	80	104	108
	Kg	0.451 ± 0.054	0.461 ± 0.063	0.464 ± 0.061
	χ^2 test	C1–R1 P < 0.05	R1–ST1 NS	–
		C1–ST1 P < 0.05		
Slaughter	n	106	98	119
	Kg	0.478 ± 0.060	0.496 ± 0.062	0.491 ± 0.060
	χ^2 test	C1–R1 P < 0.05	R1–ST1 NS	–
		C1–ST1 NS		

NS = non-significant

In the second series of experiments, on day 149 and at the time of slaughter the average body weight of the treated groups was higher than that of the control group (Table 6). This is also supported by the data of daily body weight gain (Table 7).

Table 6

Body weight of pigs in the second experiment

Time	Statistics	C2	R2	ST2
Weaning	n Kg χ^2 test	595 9.67 ± 1.07 C1–R1 NS C1–ST1 P < 0.05	520 9.18 ± 10.28 R1–ST1 P < 0.01	520 –
90 days	n Kg χ^2 test	80 34.26 ± 6.37 C1–R1 P < 0.05 C1–ST1 NS	28 31.43 ± 2.86 R1–ST1 P < 0.01	40 34.65 ± 4.87 –
140 days	n Kg χ^2 test	51 66.94 ± 8.53 C1–R1 NS C1–ST1 NS	55 67.02 ± 8.45 R1–ST1 NS	52 69.83 ± 8.95 –
Slaughter	n Kg χ^2 test	99 94.52 ± 21.95 C2–R2 P < 0.001 C2–ST2 P < 0.001	120 107.82 ± 10.48 R2–ST2 NS	120 106.60 ± 12.50 –

Table 7

Daily body weight gain of pigs in the second experiment

Time	Statistics	C2	R2	ST2
Weaning	n Kg χ^2 test	67 0.296 ± 0.033 C2–R2 P < 0.05 C2–ST2 NS	57 0.278 ± 0.031 R2–ST2 NS	51 0.298 ± 0.026 –
90 days	n Kg χ^2 test	80 0.365 ± 0.068 C2–R2 NS C2–ST2 NS	56 0.349 ± 0.032 R2–ST2 P < 0.01	80 0.384 ± 0.054 –
140 days	n Kg χ^2 test	51 0.446 ± 0.057 C2–R2 NS C2–ST2 0.05	55 0.453 ± 0.057 R2–ST2 P < 0.05	42 0.472 ± 0.06 –
Slaughter	n Kg χ^2 test	106 0.468 ± 0.082 C2–R2 P < 0.001 C2–ST2 P < 0.001	120 0.525 ± 0.051 R2–ST2 NS	120 0.527 ± 0.061 –

At the time of slaughtering pigs in the different experimental groups the distribution of animals according to ‘EUROP’ quality criteria was also determined. The number of animals given ‘R-P’ grading was higher in the control groups, while in the vaccinated and medicated groups the ratio of animals with ‘E-U’ qualification increased (Table 8).

Table 8

Distribution of the experimental pigs according to the ‘EUROP’ slaughtering categories

Group		E	U	R	O	P
C1	n 155	11 (7.1%)	83 (53.5%)	54 (34.8%)	7 (4.5%)	–
R1	n 120	12 (10.0%)	52 (43.3%)	46 (38.3%)	10 (8.3%)	–
ST1	n 118	39 (33.0%)	48 (40.7%)	24 (20.3%)	5 (4.2%)	2 (1.7%)
C2	n 120	17 (14.2%)	63 (52.5%)	35 (29.2%)	4 (3.3%	1 (0.8%)
ST2	n 117	30 (25.6%)	56 (47.9%)	26 (22.2%)	5 (4.3%)	–

At the end of the experiment the sales revenues per one kilogram of body weight marketed, which are related to the body weight and the meat quality, were calculated. In addition, the costs of feed required for the production of one kg body weight and the costs of medication were also determined (Table 9).

Table 9

Sales revenues, feed costs and medication costs per 1 kg of finishing pig marketed

Groups	Sales revenues Ft/kg	Feed cost Ft/kg	Medication cost Ft/kg	Sales revenues minus feed and medication costs (Ft/kg)
C1	166.46	88.09	–	78.37
C2	168.60	83.23	–	85.37
R1	162.73	85.01	1.94	75.78
R2	173.44	80.28	2.98	90.18
ST1	170.92	82.72	0.88	87.32
ST2	171.24	73.07	1.26	96.91

Remark: the sales revenues and the costs of feed and medication were calculated at the prices valid at the time of the experiment

The data presented in Table 9 indicate that the feeding costs were the highest (88.09 Forints) in the control group (C1), followed by Group R2 (80.28 Forints) and Group ST2, in which the lowest cost was obtained (73.07 Forints). Considering that in pig production the cost of feed represents the largest cost item, it is important to ensure that the cost of feed accounts for the lowest possible proportion of the sales revenues. Table 9 shows that this ratio was 52.91% and 49.36% in the control groups and 46.78% in the groups immunised twice with Respisure. The ratio was also outstandingly favourable (42.67%) in Group ST-2.

Discussion

Despite the acceptable management conditions that prevailed after restocking the farm, pneumonia still developed and the damage caused by it increased over time, which could be confirmed by the inspection of lungs (Table 3). Also in that case, the economic losses due to mycoplasmal pneumonia could be markedly reduced both by medication and by the use of Respisure vaccine; namely, the number of pigs that died, were emergency slaughtered or were retarded in growth was significantly reduced while the clinical signs and the lung lesions became milder. In addition, in the treated groups the number of animals affected with pneumonia and especially the score indicating the severity of pneumonia decreased significantly. This improvement in the clinical status of animals was accompanied by a higher daily body weight gain in the treated groups.

According to the recommendations of Pfizer, Respisure vaccine should be used at 1 and 3 weeks of age, probably in order to ensure that immunity develops even before an infection could take. In this experiment the vaccine was used relatively late as during the preliminary studies antibodies to *M. hyopneumoniae* could not be detected even in 3 months old piglets. This indicated that infection took place very late in the given herd. Late vaccination was expected to result in more prolonged immunity. This was in accordance with the observation that no difference was demonstrable between the treated and the control groups in body weight and daily body weight gain at weaning and in several cases at 90 days of age; however, later on both parameters improved in the treated groups. The favourable body weight gain observed in the treated groups was accompanied by an increased ratio of animals belonging to the 'E' and 'U' slaughter categories, which resulted in increased profitability.

The treatment is justified by economic considerations. A negligible part of the sales revenues covers the cost of treatments of different strategies, and that cost is recovered multiple times during the fattening period, which is clearly indicated by the feed cost to sales revenues ratio. Even the highest per-unit cost item, i.e. the cost of two immunisations with Respisure, represents only 1.71% of the sales revenues per 1 kg, and that treatment results in one of the most favourable sales revenues to feed cost ratios (46.78%). The corresponding values obtained in Group ST2 were 0.73% and 42.67%, respectively. Antibiotic treatment appears to be more favourable as it acts also on pathogens other than mycoplasma, e.g. on streptococci. Treatment of the respiratory disease complex of pigs, given either in the form of immunoprophylaxis or antibiotic therapy, plays a decisive role in the efficiency and profitability of pig production.

By presenting these data our objective is to show that the money spent on animal health should not be considered 'an inevitable, planned cost item'; rather, it should be regarded as an investment which will be recovered multiple times in the fattening period already by the reduction of the feed costs, not to speak of the reduction of mortality and emergency slaughter and the economic benefit arising from the treatments saved. An additional advantage is that the treatment results in a uniform stock for slaughter, which enables the simultaneous implementation of 'all in/all out' procedures, which is the most important requirement.

Immunoprophylaxis will enjoy priority in the future, as recently consumers show increased reluctance to consume meat from animals for slaughter that have received prolonged antibiotic treatment.

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