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COMPATIBILITY AND ANTICOCCIDIAL ACTIVITY OF LASALOCID AND SALINOMYCIN WITH OR WITHOUT ANTIBIOTICS (VIRGINIAMYCIN AND AVOPARCIN) AGAINST EIMERIA MIXED INFECTION IN CHICKS

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SUMMARY

An experiment was conducted to investigate the effectiveness of feeding diets supplemented with either lasalocid (37.5 ppm) or salinomycin(30 ppm) in the presence or absence of virginiamycin(20 ppm) or avoparcin (10 ppm) on performance of broiler chicks challenged with coccidia.The effectiveness of drugs against major pathogenic species of Eimeria in chicks (coccidiosis lesions) and mortality was also studied .

Four hundred, day-old Arbor Acres chicks were fed a starter diet for the first two weeks of age ,then fasted over-night and individually weighed. The birds were randomly distributed into 40 groups of 10 chicks each in battery brooders. Four replicates were used for each of the tested ten dietary treatments. The medicated feed was fed two days before infection and then for a total of nine consecutive days until the end of the experiment. The infection was induced by giving orally to each bird a suspension containing 100,000 sporulated oocyst of mixed Eimeria.

The coccidiostat lasalocid or salinomycin in combination with the antibiotic virginiamycin or avoparcin exhibited a higher degree of anticoccidial activity against a mixed Eimeria infection in broiler

chicks in terms of preventing or reducing mortality and suppressing lesion scores when compared to infected unmedicated control.

The coccidiostat-antibiotic combinations allowed for significant($P<0.05$) increases in gains and improvements in feed conversion over chicks fed either coccidiostats alone or antibiotics alone.

The lasalocid (37.5 ppm) or salinomycin (30 ppm) when combined with virginiamycin (20 ppm) or avoparcin (10 ppm) is safe,effective and compatible to use in broiler feed, and could be used satisfactory for the control of coccidiosis.

Keywords: Lasalocid, salinomycin, virginiamycin, avoparcin, coccidiosis, eimeria, broiler

INTRODUCTION

Coccidiosis is one of the most diseases of poultry worldwide and is characterized by enteritis. Chicken coccidiosis is one of the serious diseases of intensive poultry production with special prevalence under warm and humid conditions. Coccidiosis is caused by protozoan parasites of the genus, Eimeria. The various genera of coccidia are distinguished by the number of sporocysts and sporozoites contained in the oocysts. Being in the last decade of this century, poultry producers are still faced with increasing loss of sensitivity and resistance to a number of anticoccidial drugs and few new drugs under development. However, the future for coccidiosis control remains good with the utilization of currently available anticoccidials and development of strategies to control coccidiosis.

The purpose of the present experiment was to investigate the effectiveness of feeding diets supplemented with either lasalocid (37.5 ppm) or salinomycin(30 ppm) in the presence or absence of virginiamycin(20 ppm) or avoparcin (10 ppm) on performance of broiler chicks challenged with coccidia. The effectiveness of drugs against major pathogenic species of Eimeria in chicks (coccidiosis lesions) and mortality was also studied.

MATERIALS AND METHODS

Four hundred, day-old Arbor Acres chicks were fed a starter diet containing 22% CP and 3000 Kcal ME/Kg (Table 1) for the first two weeks of age, then fasted over-night and individually weighed. The birds were randomly distributed into 40 groups of 10 chicks each in battery brooders. Four replicates were used for each of the tested ten dietary treatments. The medicated feed was fed two days before infection and then for a total of nine consecutive days until the end of the experiment. The infection was induced by giving orally to each bird a suspension containing 100,000 sporulated oocyst of mixed Eimeria. The preparation of Eimeria culture is described in details by El-Nagmy (1994).

The experimental treatment design could be summarized as follows:

1- Uninfected, unmedicated control.(UUC)
2- Infected , unmedicated control.(IUC)
3- IUC + 20 ppm Virginiamycin.
4- IUC + 10 ppm Avoparcin.
5- IUC + 37.5 ppm Lasalocid.
6- IUC + 30 ppm Salinomycin
7- IUC + 20 ppm Virginiamycin + 37.5 ppm Lasalocid.
8- IUC + 10 ppm Avoparcin + 37.5 ppm Lasalocid.
9- IUC + 20 ppm Virginiamycin + 30 ppm Salinomycin
10- IUC + 10 ppm Avoparcin + 30 ppm Salinomycin

The basal starter diet was supplemented with methionine, lysine and vitamin and mineral mixture to cover the chick requirements (NRC 1984). The metabolizable energy of diet was calculated according to reported values of (NRC 1984).

Diets and water were offered ad-libitum over the experimental period. Chicks were kept under similar management conditions. Artificial lighting was provided all over 24 hours daily. Electric and gas heaters were used to provide the chicks with heat needed for brooding. Chicken were vaccinated against New castle disease two times, firstly with Hitchner - B_1 eye drops on the 5th day of age and secondly with Lasota strain in drinking water at 18 days of age. Body weight, feed consumption and mortality rate were recorded throughout the experimental period. The feed conversion values were

calculated as the amount of feed consumption per unit of body weight gain.

Table 1. Composition of the experimental basal diet

Ingredients %	Starter diet	Determined values(%)	
Yellow corn	63.85	Moisture	9.18
Soybean meal(44%)	22.57	Ash	5.53
Corn gluten (60)	6.20	CP	21.70
Fish meal (70%)	3.80	CF	3.05
Lime stone	1.53	EE	3.15
Dicalcium phosphate	1.40	NFE	57.39
Salt	0.20		
Vitamin & mineral mix.*	0.25	Total	100.00
DL-Methionine	0.13		
L-Lysine HCl	0.07	Calculated value	
Total	100.00	ME Kcal/Kg	3002

* Each 2.5 kg of vitamin and mineral mixture (Pfizer Company) contains:Vitamin A, 12000000 I.U; Vitamin D_3, 2000000 I.U; Vitamin E, 10 g; Vitamin K, 2g; Vitamin B_1, 1 g; Vitamin B_2, 4 g; Vitamin B_{12}, 10 mg; Niacin, 20 g; Pantothenic acid, 10 g; Vitamin B_6, 1.5 g; Folic acid, 1 g; Biotin, 50 mg; Choline, 500 g; Iron, 30 g; Copper, 10 mg; Zinc, 55 g; Manganese, 55 g; Iodine, 1 g; Selenium, 100 mg; B.H.T, 125 g; D.O.T, 125 g.
The inclusion rate was 2.5 kg / Ton of feed.

Average degree of infection (ADI)

Coccidiosis lesions were scored by a modification of the method of Johnson and Reid (1970). Diagnosis was based on lesion location and morphology. The readings obtained were recorded as an average degree of infection (ADI)according to the following scoring system.
0 = normal , 1 = slight , 2 = moderate , 3 = severe and 4 = dead.
The chemical analyses of the ingredients and diets were determined according to the official methods of Association of Official Analytical Chemists (1980)
Data were analyzed by ANOVA using the General Linear Model Procedure of SAS® software (SAS Institute, 1986). When significant ($P \leq .05$) differences were obtained, Duncan's new multiple range test (1955) was used to separate treatment means. Arcsine transformation was applied to ADI and mortality data prior to analysis. The following model was used for chick performance.

$Y_{ijk} = \mu + \alpha_i + \beta_j + e_{ijk}$
where:
μ =population mean
α_i = effect of treatments
β_j = effect of replication
e_{ijk} = mean random error and assumed to be independently and normally distributed with zero mean and σ^2 i.e. NID $(0, \sigma^2$

RESULTS AND DISCUSSION

The results of live body weight (LBW), body weight gain (BWG), feed intake (FI), feed conversion (FC), mortality % and ADI are shown in Table 2.

The initial LBW of two week - old chicks for all treatments were nearly similar and ranged from 286 to 294 g.

Table 2. Anticoccidial activity of lasalocid and salinomycin with and without antibiotics against Eimeria mixed infection in chicks from 14 to 25 days of age

Treatments	UUC	IUC	Virg	Avo	Las	Sal	Virg +Las	Avo+ Las	Virg +Sal	Avo+ Sal
Level (ppm)	0.0	0.0	20	10	37.5	30	20+ 37.5	10+ 37.5	20+ 30	10+ 30
Diet No	1	2	3	4	5	6	7	8	9	10
Intial body	a	a	a	a	a	a	a	a	a	a
weight(g)	287	288	292	288	292	291	294	288	286	291
±SE	1.47	2.90	2.60	1.44	1.87	1.78	0.84	2.49	1.19	3.53
Live body	c	f	d	e	c	c	b	b	a	a
weight(g)	682	512	674	648	685	687	714	709	746	747
±SE	8.58	5.17	8.68	4.37	9.00	11.46	6.42	3.47	3.57	6.24
Body weight	c	f	d	e	c	c	b	b	a	a
gain(g)	395	225	382	360	393	396	420	421	460	456
±SE	8.56	6.05	10.65	5.35	10.09	11.62	6.12	4.45	3.04	5.34
	c	e	a	b	d	d	d	d	c	c
Feed intake g)	654	560	921	860	632	635	628	634	685	688
±SE	16.54	16.09	20.45	10.02	15.06	18.69	10.63	7.68	8.40	9.60
Feed conversion	c	a	b	b	d	d	e	e	e	e
(Feed/gain)	1.66	2.49	2.42	2.39	1.61	1.60	1.50	1.50	1.49	1.51
±SE	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
	c	a	b	b	c	c	c	c	c	c
Mortality %	0.00	15.00	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00
	c	a	b	b	c	c	c	c	c	c
ADI	0.00	3.60	2.50	2.50	0.75	0.50	0.25	0.25	0.25	0.25
±SE	0.00	0.16	0.56	0.50	0.25	0.29	0.25	0.25	0.25	0.25

UUC* = Uninfected Unmedicated Control, IUC = Infected unmedicated control, Virg= Virginiamycin , Avo= Avoparcin, Las= Lasalocid, Sal= Salinomycin, ADI = Average degree of infection.
a-f Means within a row without common letters are significantly ($P<0.05$) different.

Body weight gain.

The results of BWG followed the same trend as those obtained for the LBW for all the experimental treatments (Fig. 1). All the medicated birds had significantly ($P< 0.05$) heavier BWG than the infected unmedicated control birds (IUC). The chicks fed rations containing salinomycin with either virginiamycin or avoparcin exhibited significantly ($P<0.05$) heavier BWG than those of lasalocid -antibiotic-treated birds and all other treatments. The BWG of birds fed lasalocid in combination with either virginiamycin or avoparcin were significantly ($P<.05$) higher than those fed the coccidiostats alone, antibiotics alone, IUC and UUC.

There was no significant difference in BWG between the tested two coccidiostats. The BWG of coccidiostat-treated birds (lasalocid or salinomysin) were statistically equal to that of UUC, but were significantly ($P<0.05$) higher than those of antibiotic-treated birds and IUC.

Although virginiamycin-treated birds had significantly ($P<0.05$) higher BWG than those of avoparcin-treated birds, both of these antibiotic treatments showed lower BWG than all other medicated birds, but gave significantly heavier BWG than the IUC group.

Feed intake

Chicks fed medicated diets significantly ($P< 0.05$) consumed more feed than those fed IUC. Virginiamycin-treated birds consumed significantly ($P<0.05$) more feed than avoparcin-treated birds, and both of these antibiotic-treated birds consumed significantly ($P<0.05$) more feed than those of other medicated birds.

No significant differences in FI were obtained among salinomycin -virginiamycin, salinomycin-avoparcin and UUC treated birds,although numerical higher feed intake values were observed for salinomycin - antibiotic combination treated birds than the UUC.

Although no significant differences in FI were found among lasalocid- virginiamycin, lasalocid-avoparcin, salinomycin alone and lasalocid alone treated groups,these birds still consumed significantly ($P<0.05$) more feed than IUC group.

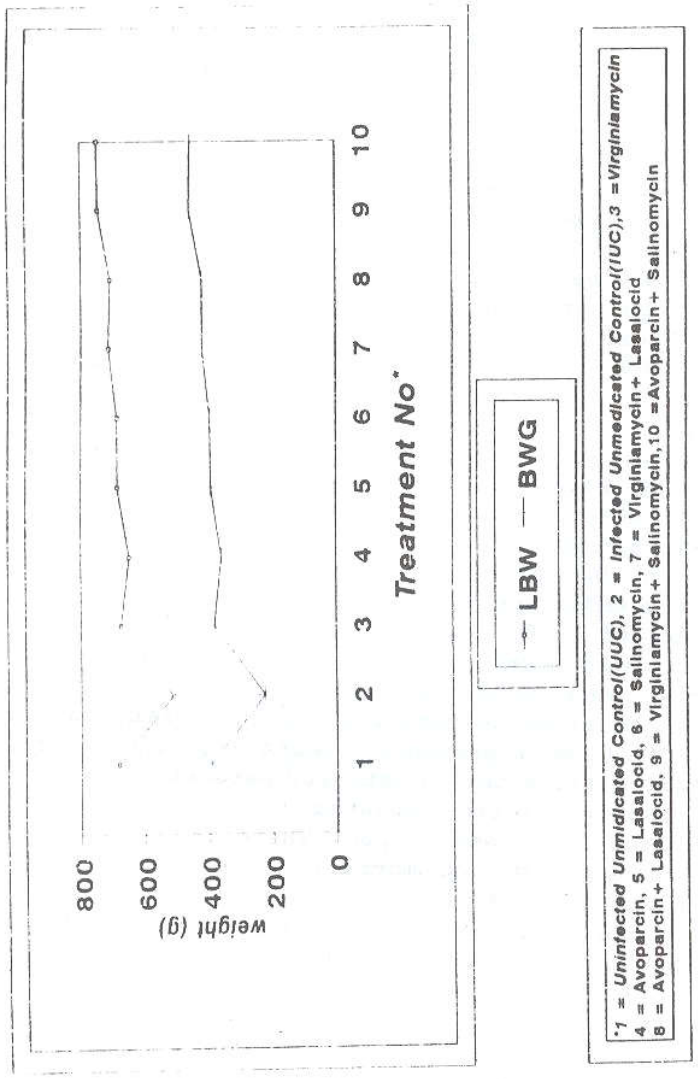

Figure 1. Anticoccidial activity of lasalocid and salinomycin with or without antibiotics against Eimeria mixed infection in chicks (live body weight & body weight gain)

Feed conversion (feed/gain)

The medicated birds had significantly ($P<0.05$) better feed conversion than those of IUC. The feed conversion values for coccidiostat- antibiotic combination treated birds were significantly ($P<0.05$) superior compared to those of the coccidiostats alone, antibiotics alone, UUC and IUC. The coccidiostats were significantly ($P<0.05$) more effective than antibiotics in improving the feed conversion values compared to those of IUC.

Parameters of activity (Mortality % and ADI)

The data presented in Table 2 showed that coccidiostat- antibiotic combinations fed to birds were highly effective in preventing mortality and reducing morbidity against an Eimeria mixed infection in broiler chicks. These combination-treated birds showed no mortality (0 %) and a distinctly lower ADI of 0.25 %. In contrast, the IUC showed an average mortality of 15 % with an ADI of 3.6.

The coccidiostats (lasalocid or salinomycin) fed alone to birds had significantly ($P<0.05$) the same effect as those of coccidiostat- antibiotic combinations in preventing mortality and reducing the lesion scores compared to the antibiotic fed alone and the IUC. The antibiotics fed alone showed an average mortality of 5% with an ADI of 2.50.

However, the combinations of coccidiostats with antibiotics were numerically more effective than the coccidiostats alone in reducing lesion scores, but were equally effective in preventing mortality. There were no significant differences in activity parameters among the coccidiostat-antibiotic- treated birds, coccidiostat-treated birds and those of UUC. Therefore, the results clearly showed that the mortality prevention and ADI values for the coccidiostats (lasalocid or salinomycin) alone and coccidiostat- antibiotic combinations were significantly superior ($P<0.05$) compared to the antibiotic alone and the IUC.

Therefore, the foregoing results of this experiment clearly demonstrated that the coccidiostats lasalocid (37.5 ppm) or salinomycin (30 ppm) in combinations with the antibiotics virginiamycin (20 ppm) or avoparcin (10 ppm) exhibited a higher degree of anticoccidial activity against a mixed Eimeria infection in broiler chicks.

Chicks fed lasalocid or salinomycin in combinations with growth promoters (virginiamycin or avoparcin) performed significantly ($P<0.05$) better for growth and anticoccidial efficacy than those fed the growth promoter alone and IUC. The coccidiostat-antibiotic combinations allowed for significant ($P<0.05$) increases in gains and improvements in feed conversion over chicks fed either coccidiostats alone or antibiotics alone. Also, these combinations allowed for numerical decreases in lesions(ADI) than chicks fed coccidiostats alone and significant ($P<0.05$) decreases in lesions than chicks fed antibiotic alone.

The two coccidiostats lasalocid and salinomycin were equally effective against Eimeria mixed infection in preventing mortality and reducing morbidity as compared to IUC. The gains of either lasalocid or salinomycin compared favourably with those of the UUC and were superior to those of virginiamycin or avoparcin alone and the IUC.

Although there were no significant differences in anticoccidial activity parameters or performance parameters between the two coccidiostats, the BWG,FC and ADI were slightly in favour of salinomycin. This might be reflected on their combinations with antibiotics since salinomycin -antibiotic-treated birds significantly ($P<0.05$) exhibited heavier BWG than lasalocid- antibiotic-treated birds.

In this respect, McDougald et al. (1981) demonstrated that although salinomycin was as effective as monensin and lasalocid in reducing the lesion scores, the body weight gain and feed conversion generally were in favour of salinomycin, under floor-pen conditions. However, Chappel and Babcock (1979) reported that under field conditions,salinomycin had some advantage over lasalocid in terms of anticoccidial activity and over monensin in terms of weight gains. Migaki et al. (1979) also observed that salinomycin at 30 ppm showed greater overall activity than did lasalocid at 37.5 ppm.

Although the antibiotic-treated birds exhibited significant ($P<0.05$) decreases in lesions than the infected unmedicated control (IUC), their lesion scores (ADI) were still significantly ($P<0.05$) higher than those of coccidiostat-treated birds. However, all the medicated chicks exhibited significant ($P<0.05$) decreases in lesions than the IUC.

The combinations of coccidiostats with antibiotics had similar effects to those of coccidiostats alone in preventing mortality as compared to the antibiotic alone and IUC. The antibiotics fed alone significantly ($P<.05$) reduced mortality compared with those obtained for IUC.

It seemed that growth promoters (virginiamycin and avoparcin) did not interfere with the anticoccidial activity of either lasalocid or salinomycin. This supports the findings of Mitrovic et al. (1975) and Schildknecht et al. (1980 a,b) who demonstrated that lasalocid's anticoccidial activity was not affected by the presence of antibiotics in broiler feed.

The growth promoters fed alone exhibited no anticoccidial activity in terms of mortality and ADI as salinomycin or lasalocid alone. However, when the coccidiostats (lasalocid or salinomycin) were combined with antibiotics (virginiamycin or avoparcin), the combinations resulted in significantly ($P<0.05$) improved performance, prevented mortality and reduced lesion scores over the antibiotics alone and IUC.

Although salinomycin or lasalocid were as effective as their combinations with antibiotics(virginiamycin or avoparcin) in reducing the lesion scores and preventing mortality, the gains and feed conversion were significantly ($P<0.05$) in favour of their combinations rather than either alone. These results are in general agreement with those obtained by Mitrovic et al. (1975) and Schildknecht et al. (1980a,b) who showed the highly anticoccidial activity and the compatibility of lasalocid in combinations with antibiotics against Eimeria mixed infection in chicks.

The present data support the previous finings of many investigators who confirmed the superiority of salinomycin or lasalocid in combinations with antibiotics in preventing mortality and/or reducing lesion scores and improving the body weight gains and feed conversion of broiler chicks rather than either alone (Schildknecht et al., 1980 a,b; McDougald et al., 1981; Waldroup et al., 1986; Salmon and Stevens 1990).

It could be concluded from the present results and discussion that the coccidiostat- antibiotic combinations could be used satisfactory for the control of coccidiosis. This is of extreme importance, since such infection is most likely to be present under practical field conditions in Egypt. The salinomycin

(30 ppm) or lasalocid (37.5 ppm) when combined with virginiamycin (20 ppm) or avoparcin (10 ppm) is safe, effective and compatible to use in broiler feed. The combinations of antibiotics (avoparcin or virginiamycin) with coccidiostats(salinomycin or lasalocid) have shown not to interfere with the anticoccidial activity of either salinomycin or lasalocid alone against a mixed Eimeria infection.

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مدى توافق مضادات الكوكسيديا (لاسالوسيد او سالينومايسين) فى وجود أو عدم وجود المضادات الحيوية (فرجنيناميسين او افوباريسين) وكفاءتها ضد الايمريا فى الكتاكيت المعروضة للعدوى الصناعية بالكوكسيديا

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الغرض من هذا البحث هو دراسة تأثير الادوية المستخدمة لاسلوسيد (٣٧,٥ أو ٧٥ ملجم / كجم علف) او سالينومايسين (٣٠ملجم /كيلو جرام علف) فى وجود او عدم وجود فرجينيامايسين (٢٠ملجم/كيلو جرام علف) او افربارسين (١٠ ملجم / كيلو جرام علف) على انتاجية كتاكيت التسمين المعروضة للعدوى بالكوكسيديا ومدى كفائتها ضد الايمريا.
استخدم فى هذه الدراسة ٤٠٠ كتكوت اربرايكرز عمر يوم حيث غذيت على علقية بادىء لمدة اسبوعين وبعد ذلك تم وزن الكتاكيت وتوزيعها عشوائيا فى بطاريات على ٤٠ مجموعة تجريبية كل مجموعة ١٠ كتاكيت حيث استخدم ١٠ معاملات تجريبية بكل منها ٤ مكررات وتم تغذية الكتاكيت عند عمر ١٤ يوم على العلائق التجريبية لمدة يومين قبل العدوى الصناعية عن طريق الفم باستخدام ١٠٠٠٠٠ اووسيست متحوصل من الايمريا.

ويمكن تلخيص النتائج والاستنتاجات المتحصل عليها فى الأتى:
- ادى خلط منشطات النمو مع مضادات الكوكسيديا الى زيادة معنوية فى وزن الجسم المكتسب وتحسن معامل التحويل الغذائى مقارنة بالمجموعة التى غذيت على علائق تحتوى على منشطات النمو أو مضادات الكوكسيديا كل على حدة.
- ادى خلط منشطات النمو مع مضادات سالكوسيديا الى خفض درجة الاصابة (ADI) مقارنة بالكتاكيت المغذاه على مضادات الكوكسيديا فقط. كما ادت الى خفض درجة الاصابة معنويا الاصابة معنوية بمستوى ٥٪ مقارنة بالمجموعة التى غذيت على منشطات نمو فقط.
- كانت كفاءة الاسالوسيد متماثلة مع السالينومايسين فى خفض نسبة النفوق ودرجة الاصابة بالمقارنة بمجموعة الطيور المصابة والتى لم تؤخذ اى اضافات علاجية (IUC).

– وجد انه يمكن استعمال مخلوط السالينومايسين بمعدل ٣٠ملجم/كيلو علف أو اللاسالوسيد بمعدل ٣٧,٥ ملجم/كيلو علف مع الفرجنيامايسن (٢٠ملجم/كيلو علف) او الافوبارسين (١٠ملجم/ كيل علف) بأمان وبدون اى اضرار حيث ثبت فاعلية هذه المخاليط وملاءمتها للاستعمال فى علائق كتاكيت التسمين ٠ وعلى ذلك فهى تعتبر كافية ومرضية للتحكم فى الاصابة بالكوكسيديا ورفع اداء الكتاكيت٠