Efficacy of bridging the gap in shuttle programs controlling coccidiosis on growth performance in broilers diets

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ABSTRACT: The experiment was evaluated the efficacy of a single programs of four anticoccidial products in broiler diets with four anticoccidial products (salinomycin 60 ppm, lasalocid 90 ppm, robenidine 33 ppm, maduramycin 5 ppm) for the whole period (1-35d) or with 3 shuttle programs (robenidine and salinomycin, robenidine and lasalocid and robenidine and maduramycin) for 1-14d and 15-35d compared with negative control (NC). Seven hundred and sixty eight mixed sex Arber Acres (1d-old) were assigned randomly to 8 dietary treatments (24 birds per pen with 4 pens per treatment). All testing diets were formulated in four cycle periods (1-14d, 15-28d, 29-35d and withdrawal anticoccidial products 36-42d). Chicks fed with four anticoccidial products by single or shuttle programs showed no difference (P>0.05) in body weight (BW), body weight gain (BWG), feed intake (FI), feed efficiency (feed conversion ratio, FCR), percentage of survival rate (SR) and Productive Index (PI) among treatment groups for all periods of testing (1-14, 15-35, 1-35, 36-42, and overall period 1-42d) except for FI and FCR during 1-14d. For the overall periods of testing showed that feeding four anticoccidial products showed greater on PI when compared with NC except shuttle program robenidine and salinomycin. When evaluated on the prices of anticoccidial product for evaluate the economic benefits return over the NC showed that salinomycin showed the best, lasalocid showed the second and shuttle programme robenidine and lasalocid showed the third. Using single program showed better efficacy anticoccidial effects more than shuttle programs.
Keywords: broiler, anticoccidial products, performance, productive index, economic benefits return

Introduction

Coccidiosis occurs in mammals and avian species. In domestic poultry, the disease is caused by the protozoa, *Eimeria* and is characterized by intestinal lesions. Coccidiosis is extremely costly to commercial poultry production because of medication and lost performance (Williams, 1998, 1999; Dalloul and Lillehoj, 2005). Vaccinating for coccidiodis, although generally accepted as a safe alternative to anticoccidial use, can be detrimented to bird performance. Compared with anticoccidial use, nonatlennated vaccines result in poorer early weight gain and feed conversion (Mathis, 1999), which is difficult to recover before slaughter (Williams, 1998). Prior to the 1980s the broiler industry main strategy to control coccidiosis was “straight medication” that is a single anticoccidial per growout flock. However, during the 1980s “shuttle programs” were developed as tools to control coccidiosis. One of the important features of shuttle programs was that they showed the development of drug resistance in coccidia. Shuttle programs consist

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of a starter medication, usually for the first three weeks of the growout, then a change to a grower product, which may be followed by drug-free withdrawal or a medicated "finisher" product (MaDougald, 1990; Merck VeterinaryManual, 1991). Shuttle programs are now widely used in commercial broiler operation. Therefore the present of this study was to examine straight or a single anticoccidial products compared with shuttle programs to combat coccidiosis with an effective "crossover" product can provide improved broiler chicks performance.

Materials and methods

A total of 768 day-old mixed-sex of commercial broiler strain (Arbor Acres) were randomly assigned into eight treatments with 4 replications of 24 chicks with equal sex per replicate. The basal experimental diets for the starter 1 (1-14d), starter 2 (15-28d), grower (29-35d) and finisher (36-42d) were respectively 23.06, 20.74, 19.00 and 18.58% CP (**Table 1**). The four anticoccidial products being used straight or single per growout flock (1-35 days) as following: (Treatment 1), salinomycin 60 ppm; (Treatment 2),lasalocid 90 ppm; (Treatment 3), robenidine 33 ppm; (Treatment 4), maduramycin 5 ppm and the three shuttle (1-14 and 15-35 days) being used as following : (Treatment 5), shuttle program of robenidine 33 ppm and salinomycin 60 ppm; (Treatment 6), shuttle programme robenidine 33 ppm and lasalocid 90 ppm; (Treatment 7), shuttle programme robenidine 33 ppm and maduramycin 5 ppm and also a standard negative control (NC) without anticoccidial (Treatment 8). At the end of the experiment (42d of age) birds were randomly selected with equal weight (three males and three females) from each pen and blood samples were collected for hematological determination and serum biochemical analyses. All data were subjected to ANOVA using the GLM procedure of SAS software (SAS, 1996). Differences among mean were detected by Duncan's multiple range tests. A level of $P \leq 0.05$ was used as the criterion for statistical significance.

Results and discussion

All data were computed and analyzed for four cycle periods (d1-14, d15-35, d36-42 and overall periods d1-42) (**Table 2**). There was no difference ($P>0.05$) in BW, BWG, FI, FCR, SR and PI among treatment groups for four cycle periods of testing except during 1-14d showed effect ($P<0.05$) on FI and FCR. The results from this period showed that the birds fed with NC showed the lowest FI with the highest feed efficiency which was manifest in a highest PI but not significant among the treatment groups supplementation with the four anticoccidial products.

During 1-35d, showed the efficacy of using continuous straight or single of four anticoccidial products compared with the three shuttle programs and the NC. The results from these study by using PI indicated salinomycin showed the highest, lasalocid showed the second, robenidine showed the third and maduramycin showed the lowest. For the three shuttle programs when compared with the four single continuous indicated that using shuttle programs showed lower efficacy of anticoccidial products when compared with the straight or single use except for treatment 6 shuttle programs robenidine

33 ppm and lasalocid 90 ppm. Shuttle programs anticoccidial by using PI showed lower efficacy of performance when compared with the NC.

During 36-42d, showed the efficacy of withdrawal period of using anticoccidial products. The results from these study showed using anticoccidial products single continuous or shuttle programs showed beneficial with higher in PI when compared with the NC.

For the overall period of testing (1-42d) showed that salinomycin showed the highest of PI, lasalocid showed the second, shuttle robenidine and lasalocid showed the third, maduramycin showed the fourth, robenidine showed the fifth, shuttle robenidine and maduramycin showed the sixth, NC showed the seventh and shuttle robenidine and salinomycin showed the lowest. When choosing an anticoccidial product one will also have to take price into consideration. The results from these experiment (**Table 3**) showed that salinomycin showed the highest economic benefits return, lasalocid showed the second, shuttle robenidine and lasalocid showed the third, robenidine showed the fourth which showed higher than the NC group and both shuttle programs robenidine and maduramycin and robenidine and salinomycin showed lower economic benefits return than the NC.

Conclusion

The results from this experiment clearly demonstrated that single anticoccidial product per growout flock showed better performance and full control of the infection in broilers when compared with the shuttle programs. A great variation in price exists between the various anticoccidial products available. Salinomycin showed decreasing feed cost per kilogram body weight gain and showed the highest economic benefits return when compared with the other anticoccidial products and the negative control no added group. Shuttle programs robenidine and maduramycin or robenidine and salinomycin showed lower economic benefits return when compared with the NC group.

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Table 2 Effects of anticoccidial products on growth performance

Dietary treatment	BW (kg)	BWG (kg)	FI (kg)	FCR Feed:gain	Survival %	PI
1-14d						
T1: Salinomycin	0.46	0.42	0.60[a]	1.43[a]	100.00	208.7
T2: Lasalocid	0.44	0.40	0.57[ab]	1.41[ab]	100.00	203.9
T3: Robenidine	0.46	0.41	0.59[a]	1.41 [ab]	100.00	210.6
T4: Maduramycin	0.45	0.41	0.57[ab]	1.38 [ab]	100.00	213.3
T5:Robenidine shuttle Salinomycin	0.46	0.41	0.58[a]	1.41 [ab]	100.00	208.8
T6: Robenidine shuttle Lasalocid	0.46	0.41	0.58[a]	1.41 [ab]	100.00	210.4
T7: Robenidine shuttle Maduramycin	0.45	0.41	0.57[ab]	1.44 [a]	100.00	203.2
T8: Negative control	0.45	0.41	0.54[b]	1.33 [b]	100.00	218.6
SEM	19.74	19.74	19.45	0.05		16.58
P-value	0.9529	0.9529	0.0196	0.0165		0.9184
15-35d						
T1: Salinomycin	1.87	1.40	2.42	1.72	100.00	389.1
T2: Lasalocid	1.88	1.43	2.50	1.74	97.92	384.6
T3: Robenidine	1.87	1.41	2.50	1.74	98.96	383.0
T4: Maduramycin	1.85	1.40	2.45	1.75	97.92	372.5
T5:Robenidine shuttle Salinomycin	1.83	1.37	2.44	1.78	96.88	357.2
T6: Robenidine shuttle Lasalocid	1.88	1.43	2.47	1.74	98.96	386.4
T7: Robenidine shuttle Maduramycin	1.83	1.38	2.41	1.75	98.96	374.4
T8: Negative control	1.83	1.38	2.37	1.71	98.96	380.2
SEM	129.91	114.62	178.59	0.04	3.37	41.55
P-value	0.9953	0.9901	0.9755	0.4762	0.9388	0.9687
1-35d						
T1: Salinomycin	1.87	1.82	3.01	1.66	100.00	315.0
T2: Lasalocid	1.88	1.84	3.06	1.66	97.92	308.4
T3: Robenidine	1.87	1.83	3.04	1.66	98.96	310.7
T4: Maduramycin	1.85	1.81	3.02	1.67	97.92	304.0
T5:Robenidine shuttle Salinomycin	1.83	1.78	3.02	1.70	96.88	292.5
T6: Robenidine shuttle Lasalocid	1.88	1.84	3.07	1.67	98.96	312.5
T7: Robenidine shuttle Maduramycin	1.83	1.79	2.99	1.67	98.96	302.9
T8: Negative control	1.83	1.79	2.91	1.63	98.96	311.1
SEM	129.91	129.91	192.04	0.04	3.38	30.85
P-value	0.9953	0.9953	0.9567	0.4305	0.9388	0.9776
36-42d						
T1: Salinomycin	2.19	0.33	0.76	2.34	95.83	192.5
T2: Lasalocid	2.25	0.37	0.85	2.31	95.74	223.8
T3: Robenidine	2.21	0.34	0.83	2.47	94.75	185.1
T4: Maduramycin	2.19	0.34	0.80	2.38	95.74	192.6
T5:Robenidine shuttle Salinomycin	2.19	0.36	0.83	2.34	94.49	211.8
T6: Robenidine shuttle Lasalocid	2.24	0.36	0.86	2.39	94.75	206.3
T7: Robenidine shuttle Maduramycin	2.19	0.36	0.84	2.36	93.70	208.6
T8: Negative control	2.16	0.33	0.81	2.46	93.70	179.9
SEM	173.10	49.85	81.56	0.15	2.19	40.39
P-value	0.9951	0.8422	0.7843	0.7289	0.7239	0.7912
1-42d						
T1: Salinomycin	2.19	2.15	3.78	1.76	95.83	279.2
T2: Lasalocid	2.25	2.21	3.92	1.77	93.75	278.3
T3: Robenidine	2.21	2.17	3.88	1.79	93.75	270.0
T4: Maduramycin	2.19	2.14	3.79	1.77	93.75	271.3
T5:Robenidine shuttle Salinomycin	2.19	2.14	3.86	1.80	91.67	261.9
T6: Robenidine shuttle Lasalocid	2.24	2.20	3.92	1.78	93.75	275.6
T7: Robenidine shuttle Maduramycin	2.19	2.15	3.83	1.79	92.71	267.2
T8: Negative control	2.16	2.12	3.72	1.76	92.71	266.1
SEM	173.10	173.10	270.36	0.04	4.12	30.16
P-value	0.9951	0.9951	0.9570	0.7022	0.9239	0.9899

[a,b,c]Values in the same column with a common letter are significantly different at $P<0.05$

*Productive index (PI) = $\frac{\text{BWG x Survival rate}}{\text{Age x FCR}}$

Table 1 Composition of the basal experimental diets

Ingredients (%)	Starter 1 1-14 d	Starter 2 15-28 d	Grower 29-35 d	Finisher 36-42 d
Corn (7.80 % CP)	47.15	52.76	58.05	59.53
Full fat soybean (36 % CP)	20.00	20.00	17.00	17.00
Soybean meal (46 % CP)	26.50	20.50	18.20	17.00
Dicalcium Phosphate	2.42	2.26	2.00	1.80
Limestone	1.70	1.80	1.60	1.60
DL-Methionine	0.31	0.22	0.18	0.17
L-Lysine	0.17	0.21	0.20	0.15
Rice bran oil, crude	1.00	1.50	2.00	2.00
Salt	0.40	0.40	0.40	0.40
Choline chloride 50 %	0.10	0.10	0.10	0.10
*Premix	0.25	0.25	0.25	0.25
Total	**100.00**	**100.00**	**100.00**	**100.00**
Cost (Baht/kg)	14.45	14.20	13.89	13.76
Calculated chemical analysis :				
Crude protein, %	23.06	20.74	19.09	18.58
ME, kcal/kg	3,116	3,172	3,216	3,230
Calcium, %	1.05	1.06	1.02	0.98
Avail. phosphorus, %	0.48	0.46	0.44	0.43

*NRC (1994)

Table 3 Effects of anticoccidial products on economic benefits return

Dietary treatment	FCG	SBR	NPR1	NPR2
T1: Salinomycin	55.65	98.70	43.05	19.62
T2: Lasalocid	59.41	101.40	41.99	18.68
T3: Robenidine	58.51	99.48	40.97	18.55
T4: Maduramycin	57.58	98.45	40.87	18.64
T5:Robenidine shuttle Salinomycin	59.64	98.40	38.75	17.53
T6: Robenidine shuttle Lasalocid	59.35	101.02	41.67	18.58
T7: Robenidine shuttle Maduramycin	58.40	98.66	40.26	18.25
T8: Negative control	56.49	97.25	40.76	18.87
SEM	4.85	7.78	5.63	1.76
P-value	0.9165	0.9951	0.9815	0.8649

Feed cost per gain (FCG) = feed cost (FC) / Survival

Salable bird return (SBR) = Price of live chicken (45 Baht) x BW

Net profits return per bird (NPR1) = SBR – FCG

Net profits return per kilogram (NPR2)=NPR1/BW