EFFECT OF A PERFORMANCE ENHANCER MIXTURE AS REPLACEMENT FOR ANTIBIOTIC GROWTH PROMOTERS ON PRODUCTION PERFORMANCE, EXCRETA QUALITY AND CARCASS CHARACTERISTICS OF BROILERS

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ABSTRACT

The objective of the study was to test the effectiveness of a proprietary performance enhancer mixture (PEM) as replacement for antibiotic growth promoters (AGP) in broilers. A total of 500 day-old, straight-run Cobb 500 broilers were randomly allotted to 5 treatments using a randomized complete block design with 10 replicates and 10 birds per replicate. The experimental treatments were: 1) corn-soybean meal diet (negative control, NC), 2) NC+6 ppm avilamycin (positive control, PC), 3) NC+0.05% PEM, 4) PC+0.05% PEM, and 5) PC+0.05% performance enhancer solution (PES) added to the drinking water. Production performance, excreta quality, carcass characteristics and economics were evaluated. Overall (d 0 to 34), no significant differences were observed in BW and ADG; however, AGP, PEM or PES reduced (*P*<0.04) ADFI and improved (*P*<0.003) ME efficiency compared to those without supplementation. Excreta quality score and carcass characteristics were not significantly different among treatments. The AGP, PEM or PES resulted in improved (*P*<0.02) feed cost efficiency and greater (*P*<0.05) margin over feed cost compared with those without supplementation. Therefore, the performance enhancer mixture supplemented either in the diet or the drinking water may be used as an effective replacement for antibiotic growth promoters in broilers.

Key words: antibiotics, replacements, production performance, carcass, broilers

INTRODUCTION

The widespread use of antibiotic growth promoters (AGP) in broiler feeds is due to its positive effects in controlling bacteria and animal growth, improving digestion, absorption of essential nutrients and feed conversion efficiency (Cook, 2004; Hughes and Heritage, 2004; Barug *et al*., 2006). However, increased and imprudent use of AGP resulted to antibiotic resistance (Apata, 2009) which occur when bacteria fail to respond to its dosages (WHO, 2017). McKenna (2013) claimed that transfer of resistant bacteria from poultry to humans may happen, and as a consequence, led to the ban of AGP in numerous countries

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(Castanon, 2007; Berkhout, 2010) and heightened the need to identify effective alternatives. This study tested the potential of a performance enhancer mixture (PEM) as replacement for AGP in broilers. It is a proprietary blend of *Lactobacillus* sp., *Bacillus* sp., organic acids, humic acids, plant extracts and ascorbic acid with antibacterial properties that individually, can improve growth, feed conversion efficiency and meat quality (Dibner and Buttin, 2002; Gunal *et al*., 2006; Teuchert, 2014). There has been no previous research that evaluated the efficacy of this feed additive combination to broilers, hence, this study.

MATERIALS AND METHODS

The protocol for this experiment was approved by the Institutional Animal Care and Use Committee (IACUC) of the University of the Philippines Los Baños, College, Laguna (IBS-2016-008).

A total of 500 day-old, straight-run Cobb 500 broiler chicks were first grouped to 50 lots of ten birds and the lots were blocked by initial weight and randomly assigned to five different treatments following a randomized complete block design. Each treatment had ten replicate cages per treatment with ten birds per replicate. Each cage had a feeder and drinker to allow ad libitum access to feed and water. For the first two weeks, chicks were provided with a source of heat for brooding. The experiment lasted for 34 days.

A total of four experimental diets were formulated in a three-phase diet series (Table 1). Birds were fed with the chick booster, broiler starter, and broiler finisher at d 0 to 10, 11 to 24 and 25 to 34, respectively. The experimental treatments were as follows: 1) corn-soybean meal diet (negative control, NC), 2) NC + 6 ppm avilamycin (positive control, PC), 3) NC + 0.05% performance enhancer mixture (PEM), 4) PC + 0.05% PEM, and 5) PC + 0.05% performance enhancer solution (PES) added to the drinking water. All diets were formulated to meet or exceed nutrient recommendations for Cobb 500 broilers. The chick booster and broiler starter diets were both in crumble form whereas the broiler finisher diet was in pellet form (3-mm).

Birds and feed leftovers were weighed at the end of every phase for calculation of ADG, ADFI and F/G. Data were adjusted for mortalities and culls. Daily ME intake was calculated by multiplying ME of the diet with the overall ADFI per bird and ME efficiency was calculated by dividing daily ME intake with ADG. Production efficiency index (PEI) was calculated using the following equation: PEI = [ADG × % viability × 100] / [F/G]. Uniform care and management were provided for the birds throughout the duration of the study. Finally, feed cost, value of gain, feed cost efficiency and margin over feed cost expressed on a per bird basis were calculated and compared for each treatment.

Assessment of excreta quality in each replicate was performed through visual fecal scoring. There were at least 2 independent evaluators and assessment was done twice a day (0800 and 1600 h) at d 7, 14, 21, 28 and 35. Scores ranged from 1 to 5 (Figure 1): 1 = dry; well-formed excreta with characteristic white uric acid cover, 2 = mostly dry excreta with white uric acid cover, 3 = moist excreta with white uric acid cover, 4 = wet excreta with less white uric acid cover and droppings lose their shape, and 5 = extremely wet excreta with little to no white uric acid cover. Data were summarized for the overall excreta quality score for each treatment.

For carcass characteristics, two birds per replication (one male and one female) were randomly selected at the end of the experiment. Before transport to the IAS Meat Science

Table 1. Ingredient and calculated composition (as-fed basis) of chick booster, broiler starter, and broiler finisher diets.

Item	Phase		
	Chick Booster	**Broiler Starter**	**Broiler Finisher**
Ingredient, %			
Yellow corn	50.888	54.582	65.330
Soybean meal	39.600	34.982	25.000
Coconut oil	4.701	6.396	6.280
L-lysine HCl	0.224	0.222	0.160
DL-methionine	0.527	0.403	0.230
L-threonine	0.135	0.131	0.070
L-valine	0.074	0.073	--
Monocalcium phosphate	1.268	1.010	0.970
Limestone	1.536	1.403	1.240
Salt	0.470	0.350	0.350
Choline chloride 60%	0.250	0.120	0.100
Vitamin premix[1]	0.130	0.130	0.130
Mineral premix[2]	0.100	0.100	0.100
Antioxidant	0.013	0.013	0.013
Mold Inhibitor	0.025	0.025	0.025
Phytase	0.010	0.010	0.010
Coccidiostat	0.050	0.050	0.050
Total	100.000	100.000	100.000
Calculated composition, %			
DM	89.26	89.28	88.91
AMEn[3], kcal/kg	2,945	3,088	3,176
CP (N × 6.25)	23.29	21.35	17.38
Crude fiber	2.91	2.79	2.60
Crude fat	7.72	9.40	9.39
SID[4] Lysine	1.37	1.25	0.95
SID Threonine	0.89	0.82	0.63
SID Methionine + Cysteine	1.10	0.95	0.72
SID Tryptophan	0.26	0.23	0.18
SID Valine	1.03	0.95	0.72
Ca	0.95	0.84	0.74
Available P	0.38	0.32	0.30

[1]The vitamin premix provided the following quantities of vitamins per kg of diet: Vitamin A, 1.43 MIU/kg; Vitamin D, 0.65 MIU/kg, Vitamin E, 6.5 g/kg; Vitamin K, 390 mg/kg; thiamine, 260 mg/kg; riboflavin, 910 mg/kg; pyridoxine, 390 mg/kg; niacin, 5.2 g/kg; pantothenic acid, 1.95 g/kg; vitamin B12, 1.95 mg/kg; folic acid, 195 mg/kg; [2]The trace mineral premix provided the following quantities of micro minerals per kg of diet: Fe, 9.2 g/kg; Cu, 750 mg/kg; Zn, 6 g/kg; Mn, 5 g/kg; I, 70 mg/kg; Se, 15 mg/kg.; [3]AMEn = N-corrected apparent metabolizable energy; [4]SID = Standardized ileal digestible.

Laboratory, birds were fasted for 12 hours and then weighed. Birds were dressed by cutting the jugular vein then scalded, plucked and eviscerated. The abdominal fat weight, dressed weight, dressed weight with giblets, wing, leg and breast cuts from eviscerated carcass were obtained and weighed on a precision digital scale (0.01 g). Commercial cuts and carcass yield were calculated relative to the BW at slaughter and were expressed as a percentage.

Data were analyzed using the MIXED procedure of SAS (SAS Inst. Inc. Cary, NC) with pen as the experimental unit. The model included diet as the fixed effect and block as the random effect. Least square means were calculated for each independent variable. When diet was a significant source of variation, least square means were separated using the PDIFF option of SAS adjusted using a Tukey-Kramer test. The following single-df contrasts were performed: 1) None vs. AGP, 2) None vs. PEM/PES and 3) PEM vs. PES. The α-level that was used to determine significance and tendencies between means were ≤0.05 and <0.10, respectively.

Figure 1. Excreta quality scores. Scores range from 1 to 5 (1 = dry; well-formed excreta with characteristic white uric acid cover, 2 = mostly dry excreta with white uric acid cover, 3 = moist excreta with white uric acid cover, 4 = wet excreta with less white uric acid cover and droppings lose their shape, and 5 = extremely wet excreta with little to no white uric acid cover).

RESULTS AND DISCUSSION

There were no significant differences observed in both BW and ADG among the treatments in all feeding phases and the overall period (Table 2). From d 0 to 10, birds fed the NC diet and PC + 0.05% PES had greater (*P*=0.002) ADFI than those fed the NC + 0.05% PEM diet. Birds provided PES in the drinking water also had greater (*P*=0.001) ADFI and improved (*P*=0.01) F/G than those fed diets with PEM. Likewise, birds fed diets with AGP had improved (*P*=0.003) F/G compared with those fed diets without AGP. Birds fed the PC diet and PC + 0.05% PES had improved (*P*=0.005) F/G compared with those fed the NC + 0.05% PEM diet.

From d 11 to 24, birds fed the NC and PC diet had greater (*P*=0.01) ADFI than those provided the PC + 0.05% PES treatment. Likewise, birds fed diets without supplementation had greater (*P*=0.006) ADFI than those fed diets supplemented with 0.05% PEM in the diet or 0.05% PES in the drinking water. As a result, the PEM or PES treatments had better (*P*=0.04) F/G than those without supplementation. However, birds fed diets supplemented with AGP tended (*P*=0.08) to have greater ADFI compared those fed diets without AGP. Birds fed diets supplemented with PEM also had greater (*P*=0.01) ADFI than those provided with PES in the drinking water.

From d 25 to 34, birds fed the NC, PC and NC + 0.05% PEM diet had greater (*P*=0.003) ADFI than those fed the PC + 0.05% PEM diet. As a result, birds fed the PC + 0.05% PEM diet had better (*P*=0.02) F/G compared with the NC treatment. Likewise,

Table 2. Effect of a performance enhancer mixture (PEM) as replacement for antibiotic growth promoters on growth performance, production efficiency index (PEI) and viability of broilers[1,2].

Item	Dietary Treatment					SEM	*P*-Value			
	NC	PC	NC + 0.05% PEM	PC + 0.05% PEM	PC + 0.05% PES		Diet	None vs. AGP	None vs. PEM/PES	PEM vs. PES
BW, g										
d 0	45	46	45	45	46	0.30	0.560	0.610	0.700	0.390
d 10	280	271	271	273	278	4.00	0.220	0.380	0.380	0.140
d 24	1,299	1,287	1,279	1,315	1,273	21.00	0.640	0.960	0.750	0.360
d 34	2,170	2,272	2,287	2,290	2,241	47.00	0.340	0.190	0.120	0.420
d 0 to 10										
ADG, g	23.36	22.54	22.59	22.60	22.92	0.36	0.330	0.180	0.210	0.420
ADFI, g	27.67[a]	27.30[ab]	26.12[b]	27.19[ab]	28.04[a]	0.34	0.002	0.240	0.160	0.001
F/G	1.18[ab]	1.21[b]	1.16[a]	1.20[ab]	1.22[b]	0.01	0.005	0.003	0.940	0.010
d 11 to 24										
ADG, g	71.48	72.10	72.01	70.65	70.57	1.25	0.820	0.620	0.590	0.600
ADFI, g	97.99[a]	97.80[a]	95.34[ab]	95.20[ab]	90.35[b]	1.58	0.010	0.080	0.006	0.010
F/G	1.36	1.35	1.32	1.32	1.28	0.02	0.160	0.180	0.040	0.140
d 25 to 34										
ADG, g	79.12	81.26	85.05	83.57	81.88	3.17	0.730	0.700	0.230	0.540
ADFI, g	135.26[a]	137.93[a]	133.81[a]	119.66[b]	126.93[ab]	3.37	0.003	0.040	0.005	0.960
F/G	1.72[b]	1.60[ab]	1.48[ab]	1.40[a]	1.48[ab]	0.07	0.020	0.003	<0.001	0.590

Table 2. Continued...

Item	Dietary Treatment					SEM	*P*-Value			
	NC	PC	NC + 0.05% PEM	PC + 0.05% PEM	PC + 0.05% PES		Diet	None vs. AGP	None vs. PEM/PES	PEM vs. PES
d 0 to 34										
ADG, g	62.01	62.21	63.33	63.19	61.81	1.18	0.830	0.96	0.530	0.31
ADFI, g	91.86[a]	91.98[a]	89.39[ab]	84.79[b]	85.30[b]	1.68	0.004	0.02	<0.001	0.36
F/G	1.48[ab]	1.51[b]	1.41[ab]	1.37[a]	1.38[a]	0.03	0.004	0.18	<0.001	0.88
PEI	407.00	387.00	427.00	424.00	416.00	20.00	0.570	0.78	0.220	0.67
Viability, %	97.00	94.00	95.00	91.00	92.60	2.70	0.530	0.12	0.200	0.89

[1]Values are least square means of 10 replicates per treatment with 10 birds per replicate.

[2]Treatments were: negative control (NC), NC + 6 ppm avilamycin (positive control, PC), NC + 0.05% PEM, PC + 0.05% PEM, PC + 0.05% performance enhancer solution (PES) added to the drinking water.

PEI = [ADG × % viability × 100] / [F/G].

[ab]Least square means within a row lacking a common superscript letter significantly differ ($P<0.05$).

supplementation with either AGP, PEM or PES had improved (*P*<0.03) F/G compared with those without supplementation.

Overall (d 0 to 34), birds fed the NC and PC diet had greater (*P*=0.004) ADFI than those in the PC + 0.05% PEM and PC + 0.05% PES treatment. Supplementing the diet with AGP, PEM or PES reduced (*P*<0.02) ADFI compared with those without supplementation. Birds in the PC + 0.05% PEM and the PC + 0.05% PES treatments had better (*P*=0.004) F/G compared with those fed the PC diet. Likewise, supplementing the diet with 0.05% PEM or PES in the drinking water improved (*P*<0.001) F/G compared with those without supplementation.

The effects of AGP alternatives on ADFI is equivocal. Some studies showed that both AGP and their replacements improve ADFI (Denli *et al*., 2003; Young *et al*., 2003). The higher ADFI may be due to compensation for an unbalanced gut microflora that decreases nutrient absorption (Bedford and Classen, 1993) and thus, energy requirement was not met (Giguere, 2006). Others observed lower ADFI, which may indicate that nutrient requirements were satisfied (Ashong and Brown, 2011). In contrast, other studies on AGP alternatives showed no effect on ADFI (Baurhoo *et al*., 2009; Zhang and Kim, 2014).

There has been no previous study on the feed additive combination, but in general, the observed improvements were related to F/G. Antibacterial properties of AGP promote improved F/G (Ferket, 2007). Alternative additives improve F/G since probiotics can reduce bacteria through competitive inhibition and exclusion (Denli *et al*., 2003); humic acids improve nutrient assimilation and prevent gut diseases (Islam *et al*., 2005; Trckova *et al*., 2005); plant extracts have antimicrobial properties (Beer *et al*., 2003; Ncube *et al*., 2007) and elimination of heat stress through ascorbic acids and plant extracts with antioxidant properties (Young *et al*., 2003). Plant extracts supplemented via the drinking water had better F/G due to improved digestion and more active metabolic activities (Ghazalah and Ali, 2008).

The better F/G observed with the AGP and PEM/PES combination indicate a positive interaction between antibiotics and probiotics. Antibiotics decrease pathogenic bacteria in the gut, while *Bacillus* sp. may create an environment in the gut that allows the antibiotic to be more effective (Simon *et al*., 2005; Neveling *et al*., 2017). However, there are also studies where combining antibiotics with probiotics have no effect (Gunal *et al*., 2006; Baurhoo *et al*., 2009), which may suggest that responses may be dependent on the specific combination. There were no significant differences in PEI or viability across the treatments. There are no previous studies evaluating the feed additive combination, but the present results agree with other studies evaluating other feed additives used individually (Gunal *et al*., 2006; Zhang and Kim, 2014). The PEI value incorporates growth rate, viability and feed efficiency, which can be used to assess any adverse or beneficial effect relating to health, environmental stress or feed quality. The lack of statistical difference despite improved F/G may have been partially negated by the numerically lower viability in the PEM and PES treatments.

Birds fed PC + 0.05% PEM and PC + 0.05% PES had greater (*P*=0.001) ME intake than those fed the PC diet (Table 3). The PC + PES treatment also had greater (*P*=0.001) ME intake compared with those fed the NC diet. The PC + 0.05% PEM and PC + 0.05% PES treatments also had improved (*P*<0.001) ME efficiency compared with the NC treatment. Likewise, birds fed the PC + 0.05% PEM had better (*P*<0.001) ME efficiency than those fed the PC diet. Supplementing the diet with AGP, PEM or PES had lower (*P*<0.04) ME intake and better (*P*<0.003) ME efficiency compared with those without supplementation.

Differences in ME intake may be explained by the observed differences in ADFI among the treatments; however, the significant improvement in ME efficiency in treatments supplemented with AGP, PEM or PES may indicate improved energy use because of bacteria elimination or reduction in the gut. Instead of energy used for gut maintenance, more energy is used for growth when provided with AGP and other feed additives (Giguere, 2006; Hashemi and Davoodi, 2011). There may also be synergistic effects between PEM and the AGP, as the effect on ME efficiency of the broilers was greater than when both PEM and AGP were supplemented to the diet individually.

Overall excreta quality scores were not significantly different among the treatments (Table 4). However, adding 0.05% PES to the drinking water resulted in better (P=0.03) excreta score compared with supplementing the diet with 0.05% PEM. Previous studies have indicated that plant extracts, organic acids and probiotics added to the drinking water resulted in improvements in excreta quality (Islam *et al*., 2005; Karimi Torshizi *et al*., 2010; Alabi *et al*., 2016). Probiotics in the water survive more in very acidic gut due to diluting factor of water and shorter transport times in liquids (Hogg, 2005). Drier conditions lead to a poor environment for microbes (Karimi Torshizi *et al*., 2010), which may affect its efficacy. The weights and yield of the carcass and commercial cuts of broilers were not significantly different among the treatments (Table 5). These results coincide with other studies where no significant differences in carcass characteristics were also observed with similar feed additives (Karaoglu *et al*., 2004; Attia *et al*., 2010).

The PC + 0.05% PEM and PC + 0.05% PES treatments had lower (P=0.03) feed cost per broiler compared with both the NC and PC treatments (Table 6). This was due to lower ADFI despite increased cost of supplementation. Likewise, supplementing the diet with 0.05% PEM or PES in the drinking water resulted in lower (P=0.007) feed cost and tended (P=0.07) to have greater value of gain per broiler compared with those without supplementation. The PC + 0.05% PEM treatment had better (P=0.006) feed cost efficiency compared with the NC treatment. Margin over feed cost was also greater (P=0.06) for the PC + 0.05% PEM treatment compared with birds fed either the NC or PC diet. Overall, supplementation with AGP, PEM or PES resulted in improved (P<0.02) feed cost efficiency and greater (P<0.05) margin over feed cost compared with those without supplementation.

Finding alternatives for AGP may decrease economic returns since strategies like combining different feed additives incur high costs (Teillant and Laxminarayan, 2015), especially if they are ineffective. Others claimed that supplementation of different additives and AGP can reduce input costs due to accelerated growth rate, improved F/G and lower mortality rates (Ferket, 2007; Lokapirnasari *et al*., 2017). In the present study, the improved feed cost efficiency and greater economic return in supplementing either PEM in the diet or PES in the drinking water indicate that the economic impact of the F/G response was greater than the cost of supplementation. Since the economic return was similar to those fed diets supplemented with AGP, this feed additive regardless of the route of supplementation are viable, effective replacements in broilers.

In conclusion, the performance enhancer mixture supplemented either in the diet or in the drinking water may be used as an effective replacement for antibiotic growth promoters in broilers. Future research may focus in determining the effectiveness of the product in lower dosages or identifying the specific feed additives in the combination that may have caused the improvement to reduce the cost of the product and increase economic return.

Table 3. Effect of a performance enhancer mixture (PEM) as replacement for antibiotic growth promoters on ME intake and efficiency of broilers[1,2].

Item	Dietary Treatment					SEM	*P*-Value			
	NC	PC	NC + 0.05% PEM	PC + 0.05% PEM	PC + 0.05% PES		Diet	None vs. AGP	None vs. PEM/PES	PEM vs. PES
ME intake[3], kcal/day	9,831[ab]	9,931[a]	9,566[abc]	9,294[bc]	9,211[c]	134	0.001	0.040	<0.001	0.19
ME efficiency[4], kcal/kg BWG	4,606[c]	4,469[bc]	4,276[abc]	4,069[a]	4,206[ab]	87	<0.001	0.003	<0.001	0.75

[1]Values are least square means of 10 replicates per treatment with 10 birds per replicate.
[2]Treatments were: negative control (NC), NC + 6 ppm avilamycin (positive control, PC), NC + 0.05% PEM, PC + 0.05% PEM, PC + 0.05% performance enhancer solution (PES) added to the drinking water
[3]ME intake = ADFI × ME of the diet;
[4]ME efficiency (kcal ME/kg BWG) = ME intake ÷ ADG;
[abc]Least square means within a row lacking a common superscript letter significantly differ (*P*<0.05).

Table 4. Effect of a performance enhancer mixture (PEM) as replacement for antibiotic growth promoters on excreta quality score of broilers[1,2].

Item	Dietary Treatment					SEM	*P*-Value			
	NC	PC	NC + 0.05% PEM	PC + 0.05% PEM	PC + 0.05% PES		Diet	None vs. AGP	None vs. PEM/PES	PEM vs. PES
Excreta score	1.87	1.94	2.04	1.84	1.76	0.07	0.06	0.23	0.83	0.03

[1]Values are least square means of 10 replicates per treatment with 10 birds per replicate.
[2]Treatments were: negative control (NC), NC + 6 ppm avilamycin (positive control, PC), NC + 0.05% PEM, PC + 0.05% PEM, PC + 0.05% performance enhancer solution (PES) added to the drinking water.

Table 5. Effect of a performance enhancer mixture (PEM) as replacement for antibiotic growth promoters on carcass and commercial cut yields in broilers[1,2].

Item	Dietary Treatment					SEM	*P*-Value			
	NC	PC	NC + 0.05% PEM	PC + 0.05% PEM	PC + 0.05% PES		Diet	None vs. AGP	None vs. PEM/PES	PEM vs. PES
Weight, g										
Live	2,338	2,372	2,379	2,438	2,325	65	0.76	0.66	0.60	0.30
Dressed	1,917	1,929	1,933	1,988	1,879	54	0.68	0.84	0.79	0.20
Dressed with giblets	1,988	2,017	2,029	2,075	1,971	58	0.69	0.70	0.59	0.23
Abdominal fat	25	27	24	28	23	2	0.58	0.59	0.58	0.42
Breast	686	689	680	717	683	22	0.76	0.53	0.72	0.56
Leg	492	491	503	506	477	15	0.67	0.74	0.80	0.14
Wing	212	214	214	219	216	7	0.97	0.62	0.65	0.94
Yield, %										
Dressed	81.99	81.39	81.26	81.58	80.84	0.56	0.69	0.37	0.29	0.40
Dressed with giblets	84.97	85.03	85.32	85.15	84.82	0.63	0.98	0.87	0.84	0.56
Abdominal fat	1.35	1.42	1.23	1.38	1.24	0.13	0.74	0.72	0.44	0.67
Breast	35.77	35.65	35.20	36.07	36.34	0.49	0.53	0.33	0.76	0.23
Leg	25.68	25.47	26.02	25.46	25.38	0.34	0.67	0.26	0.98	0.38
Wing	11.11	11.14	11.06	11.05	11.53	0.31	0.79	0.62	0.75	0.21

[1]Values are least square means of 10 replicates per treatment with 10 birds per replicate.

[2]Treatments were: negative control (NC), NC + 6 ppm avilamycin (positive control, PC), NC + 0.05% PEM, PC + 0.05% PEM, PC + 0.05% performance enhancer solution (PES) added to the drinking water.

Table 6. Economic analyses[1,2].

Item	Dietary Treatment					SEM	*P*-Value			
	NC	PC	NC + 0.05% PEM	PC + 0.05% PEM	PC + 0.05% PES		Diet	None vs. AGP	None vs. PEM/PES	PEM vs. PES
Feed cost[3], ₱	82.88^{a}	83.80^{a}	81.37^{ab}	79.72^{b}	79.59^{b}	1.10	0.030	0.20	0.007	0.48
Value of gain[4], ₱	181.52	189.69	190.57	194.44	187.02	3.98	0.230	0.12	0.090	0.26
Feed cost efficiency[5], ₱/kg BW	38.84^{a}	37.71^{ab}	36.37^{ab}	34.90^{b}	36.36^{ab}	0.74	0.006	0.02	<0.001	0.42
Margin over feed cost[6], ₱	98.63^{b}	105.89^{b}	109.20^{ab}	114.72^{a}	107.43^{ab}	3.72	0.060	0.05	0.010	0.33

[1]Values are least square means of 10 replicates per treatment with 10 birds per replicate.

[2]Treatments were: negative control (NC), NC + 6 ppm avilamycin (positive control, PC), NC + 0.05% PEM, PC + 0.05% PEM, PC + 0.05% performance enhancer solution (PES) added to the drinking water. Cost of supplements: PEM = ₱50.00/kg; PES = ₱620.00/bottle; AGP = ₱1,200.00/kg. Price of chick booster, broiler starter and broiler finisher were ₱26.93, 28.12, and 24.44/kg, respectively. Liveweight price was ₱85/kg.

[3]Feed cost per broiler (₱) = Total feed consumed x Price per kg of feed. Cost of supplementation of PES in the drinking water was included in the PC + 0.05% PES treatment.

[4]Value of gain per broiler (₱) = Total BWG x Live weight price per broiler.

[5]Feed cost efficiency (₱/kg BW) = Feed cost per broiler ÷ Total BWG.

[6]Margin over feed cost (₱) = Value of gain per broiler – Feed cost per broiler.

[ab]Least square means within a row lacking a common superscript letter significantly differ ($P<0.05$).

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