

Addition of sodium butyrate improves economic performances of broilers

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INTRODUCTION

As of July 2011 Philippines total chicken production was above 165 million birds and yearly consumption of dressed chicken was around 10 kg per person. Numerous factors contribute to the success of the Philippines broiler industry, and one of the main points to ensure its profitability is to provide the most suitable diet (Roxas, 2006). Feed additives, including sodium butyrate are used to achieve this objective

Physiological effects of sodium butyrate, a sodium salt of the short chain fatty acid butyric acid, have been demonstrated in several species and can be summarized as follows: control of the intestinal barrier, pathogen reduction, increase of mucin synthesis, regulation of the immune response, and positive effects on the intestinal epithelium, such as supplying energy to the colonocytes and enterocytes, and enhancing the intestinal cells proliferation, differentiation and maturation (Guilloteau et al., 2010)

The better development of the intestinal epithelium results in an increased intestinal surface that will be in contact with the feed bolus, ensuring a better digestion (Pluske et al., 1996). Therefore, using sodium butyrate in broilers chicken will result in animals with a well developed intestinal epithelium, allowing them to better digest the feed that they receive. For instance, sodium butyrate added at 0.5 or 1 kg per MT in feed of broilers can improve the energy and protein digestibility of the diet, probably because of a higher intestinal villi length of the animals (Mallo et al., 2011). This diet digestibility improvement may explain the reduction in feed conversion rate that is normally observed with the use of sodium butyrate (Mallo et al., 2010)

Besides, bactericide effects of sodium butyrate were proven against both gram- (Fernández-Rubio et al., 2009) and gram+ (Jerzsele et al., 2011) when it is enhanced by essential oils. This is another explanation why animals receiving this feed additive tend to show a better performance



To demonstrate the benefits of sodium butyrate under field conditions, a trial was conducted end of 2012 on a commercial farm located in Laguna, Philippines. This work was part of a Thesis submitted in fulfilment of the requirement for the degree of Bachelor of Science at the University of the Philippines Los Baños, College of Agriculture, Animal and Dairy Science Cluster, Animal Nutrition Division

MATERIAL AND METHODS

A total of four hundred day-old broiler chicks (Cobb) with an average live weight of 45g ± 5g with the same health condition were used in the experiment. Birds were distributed to twenty cages with twenty birds per cages. Four dietary treatments were randomly allotted following a Completely Randomized Design (CRD). Each treatment was replicated five times

The treatments were as follows:

- T1, Basal diet (control)
- T2, Basal diet with 1 kg/MT of sodium butyrate
- T3, Basal diet with 2 kg/MT of sodium butyrate
- T4, Basal diet with 3 kg/MT of sodium butyrate

The sodium butyrate used in the experiment was a feed additive produced by NOREL S.A. (Spain) and commercialized under the brand name GUSTOR Bg2. This product contains a minimum of 92% of sodium butyrate. The feeds were prepared by a commercial feed mill and consisted of starter, grower and finisher diets guaranteed to contain a crude protein (CP) of not less than 22%, 20% and 18.7% respectively. The feeds also contained not less than 2900 ME (kcal per kilogram) for starter diet and not less than 2800 ME (kcal per kilogram) for both grower and finisher diets

The poultry house used for the experiment was disinfected twice (a week before the chicks arrived and three days before). Litter materials (rice hull), paper mattings, heaters and curtains were provided for brooding. All 400 birds were given a booster diet from day of arrival up to the 7th day. Initial weighing of birds was done on the 7th day to ensure the homogeneity of the different groups. The different starter diets were given from 8th to 18th day of age, grower diets from 19th to 25th day of age and finisher diets from 26th day of age up to the harvest. The feeds were given with 4 hrs intervals every day (4:00am, 8:00am, 12:00pm, 4:00pm, 8:00pm, and 12:00am). Water was provided at all times. Artificial light was provided using 25 watts light bulbs to allow chicks to eat and drink during the night. Uniform care and management were given to all chicks throughout the experimental period. All required practices in the farm were fulfilled

Dextrose was immediately given upon the arrival of chicks to alleviate possible stress due to transport, and antibiotics were dispensed up to 5th day of age. Vitamin E + Selenium were supplemented to all the birds during their 6th, 8th, 13th and 15th to 21st day. Vitamin C 40% was also given on the 8th, 9th and 22nd to 28th days of age. The chicks were vaccinated against Gumboro Disease on the 7th and 14th day of age, while vaccination against New Castle Disease was done on the 14th day of age

Weighing of chicks and gathering of data were done on the end of each feeding stages (18th, 25th and 33rd days) throughout the feeding trial. Feed refusal and mortality were monitored and recorded. A pair of experimental birds (one male and one female) per replicate of each treatment was randomly picked and dressed at the end of the feeding trial. The live weight and the dressed weight of the birds were also recorded

The data gathered during the trial consisted of body weight and weight gain for each period, feed consumption (determined by subtracting the weight of total leftover feeds from the total weight of the feeds offered for each day), Feed Conversion Ratio (FCR), livability, and dressing percentage with and without giblets

An economic evaluation was also performed. Feed cost efficiency was calculated by multiplying the costs of feeds at starter, grower and finisher stages by the average feed consumption for each stage and then dividing by the live weight gain. Costs of chicks, feed, sodium butyrate and return from sales of finished broilers were computed to determine the income over feed and chick costs (IOFCC). Price per kilogram of broiler, day-old chicks and feeds were based on their market prices observed during the experiment. The following formula was used:
$$\text{IOFCC} = [(\text{average weight of broilers, kg}) \times (\text{Price per kg live weight of broiler})] - [(\text{Price of day-old-chicks}) + (\text{Total feed consumed}) \times (\text{Price of feed}) + (\text{Price of medicine}) + (\text{Price of sodium butyrate})] \times \text{Livability}$$

Analysis of Variance (ANOVA) for general linear models of statistical analysis system (SAS) following Completely Randomized Design (CRD) was used to analyze the data gathered on growth performance of chicks such as ADG, ADFI, FCR and FCE. The treatment means were compared using Scheffe test



RESULTS AND DISCUSSION

The results of proximate and mineral analyses performed on the different feeds were within the acceptable range of specifications (see Table 1) and conform to the recommendations of the Philippines Society of Animal Nutritionists (PHILSAN, 2010)

As shown in Table 2, initial body weight of birds at 7 days were not significantly different among groups, indicating that experimental birds were homogenous prior to the feeding trial. Significant differences were not observed on the means of treatments during the starter period (8d-18d) but broilers fed diet with the feed containing 2 kg/t of sodium butyrate had the highest body weight (0.6622 kg) and body weight gain (0.5068 kg). Significant differences were observed on both grower (19d-25d) and finisher (26d-33d) stages. The birds receiving 2 kg/t of sodium butyrate in their feed showed the highest body weight and weight gain for both grower and finisher stages

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Nutrient	Starter	Grower	Finisher
Moisture,%	10.11	10.25	10.54
Ash,%	6.57	4.48	4.57
Crude Protein,%	22.27	19.83	19.04
Crude Fiber, %	5.14	5.11	5.74
Crude Fat,%	4.09	3.05	3.81
Nitrogen free extract,%	56.82	62.28	61.3
Calcium, %	0.93	0.84	0.80
Total phosphorus, %	0.60	0.55	0.57

Table 1.- Results of proximate and mineral analyses performed on the different diets

The three treatments resulted in a significant difference versus the control. However, treatments 2 and 4 (sodium butyrate at 1 kg/t and 3 kg/t) were not significantly different from each other

Parameter	Control (T1)	1 kg/t (T2)	2 kg/t (T3)	3 kg/t (T4)
Initial BW (7 d), g	155.20	155.10	155.30	155.10
BW at 18 d, g	653.30	660.10	662.20	658.90
BW at 25 d, g	1067.10c	1092.90b	1105.90a	1149.40b
BW at 33 d, g	1577.40c	1667.40b	1755.30a	1642.70b
Body weight gain 8-18 d	498.10	505.00	506.80	503.80
Body weight gain 19-25 d	413.70d	445.80b	487.20a	434.00c
Body weight gain 26-33 d	510.30c	561.40b	605.90a	549.80b
Body weight gain 8-33 d	1422.20c	1512.30b	1599.90a	1487.60b

a, b, c, d Means within the same rows with different superscripts are significantly different (P<0.05)

Table 2.- Average body weight and weight gain of broiler chicks fed diets with different levels of sodium butyrate



No significant differences were observed for feed consumption during the different stages (see Table 3)

There were no significant differences observed on the feed conversion ratio of birds during the starter stage as shown in Table 4. However, birds receiving sodium butyrate had an improved FCR during grower and finisher stages. The best result (1.68) was obtained for birds given a diet supplemented with 2 kg/t of sodium butyrate. This improvement was significantly different when compared to the other two experimental regimes

Mortality during the trial was very low. As a result, livability was not different among the treatments (see Table 5). The statistical analysis showed no significant difference on dressing percentage among the treatments, as presented in Table 5. Results indicate that the addition of different levels of sodium butyrate in the diet did not affect the dressing percentage of broilers

Parameter	Control (T1)	1 kg/t (T2)	2 kg/t (T3)	3 kg/t (T4)
FC 8-18 d, g	768.60	765.80	769.60	768.40
FC 19-25 d, g	822.00	823.00	824.00	823.00
FC 26-33 d	1210.30	1213.40	1205.30	1208.50
FC 8-33 d	2800.90	2802.20	2798.90	2799.90

Table 3. Average feed consumption (FC) of broiler chicks fed diets with different levels of sodium butyrate

Means are not significantly different (P>0.05)

Parameter	Control (T1)	1 kg/t (T2)	2 kg/t (T3)	3 kg/t (T4)
FCR at 18 d	1.40	1.38	1.38	1.39
FCR at 25 d	1.63a	1.57b	1.51c	1.59b
FCR at 33 d	1.87a	1.77b	1.68c	1.79b

Table 4. Average feed conversion ratio (FCR) of broiler chicks fed diets with different levels of sodium butyrate

a, b, c Means within the same column with different superscripts are significantly different (P<0.05)

Parameter	Control (T1)	1 kg/t (T2)	2 kg/t (T3)	3 kg/t (T4)
Livability, %	100.00	100.00	100.00	99.00
Dressing percentage, %				
With giblets	80.11	79.75	80.77	78.05
Without giblets	75.15	75.35	75.65	73.36

Table 5. Average livability and dressing percentage of broilers fed diets with different levels of sodium butyrate

Means are not significantly different (P>0.05)

ECONOMIC ANALYSIS

The feed cost efficiency (determined by dividing average feed consumption by the average weight gain of the bird) was evaluated for the different treatments and different stages. It can be observed that birds fed with different levels of sodium butyrate exhibited an improvement on feed cost efficiency (FCE) versus the control, and that the addition of sodium butyrate at 2 kg per t of feed gave the most improved FCE (difference of 9.2% when compared to control)

Parameter	Control (T1)	1 kg/t (T2)	2 kg/t (T3)	3 kg/t (T4)
Total feed cost, PHP/bird	65.44	66.92	66.85	66.86
Chick cost, PHP	22.00	22.00	22.00	22.00
Total Cost, PHP	87.44	88.92	88.85	88.86
Average live weight, g	1577.40	1667.40	1755.30	1642.70
Livability, %	100.00	100.00	100.00	99.00
Sales from finished broilers, PHP	137.23	145.06	152.71	142.91
IOFCC, PHP per broiler	49.79	56.14	63.86	54.05
IOFCC, USD per broiler	1.20	1.35	1.54	1.30

Table 6. Income over feed and chick cost (IOFCC) of broilers fed diet with different levels of sodium butyrate

Assumptions:

Selling price of finished broilers = 87 PHP/kg
1 USD = 41.5 PHP

The improvement in the IOFCC was due to the significantly higher live weight and better FCR for the broilers given diets with sodium butyrate, despite higher costs per kg of feed

Table 6 shows the income over feed and chick cost (IOFCC) of broilers fed diets with different levels of sodium butyrate. There was an improvement on IOFCC by adding sodium butyrate in the diet. Broilers fed with control diet had the lowest IOFCC (49.79 PHP) while those given a feed with 2 kg per MT of sodium butyrate had the highest IOFCC (63.86 PHP, an improvement of 28.3%). This means for instance that in a house of 10,000 broilers, the extra income would be PHP 140,700 (or USD 3,390)

SUMMARY AND CONCLUSIONS

A 33-day feeding trial was conducted to determine the effects of sodium butyrate on the production performance of broilers. A total of 400 birds were distributed to 4 dietary treatments following a Completely Randomized Design (CRD) with 5 replicates per treatment. Sodium butyrate (GUSTOR B92) was added at levels of 0.0, 1.0, 2.0 and 3.0 kilograms per MT of the starter, grower, and finisher diets. The results of this study indicate that birds fed a diet with 2 kg/t of sodium butyrate had the highest body weight and the lowest FCR. Inclusion of sodium butyrate showed no significant differences on feed consumption, livability and dressing percentage. Significant differences were observed for the economic analysis, with best results obtained for treatment 3 (2 kg/t of sodium butyrate)

Under the conditions on this study, it can be concluded that adding sodium butyrate in feed had a positive effect on the growth performance of broilers. The result showed that supplementing the feeds with 2 kg/t of sodium butyrate can significantly improve the body weight gain of broilers and enhance feed efficiency. At this dosage,

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