Dietary adjustment in sodium for growing broilers: Bicarbonate or sulphate?

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Sodium supplementation for animal feed must meet the level needed by the animal and take into account a balance between Na^+, K^+ and CL^- to respect the Dietary Electrolytic Balance (DEB). A recent publication (Oviedo-Rondón ***&* *al*.**, 2001) reported on an optimal supply for Na^+ of 0.28 % and for Cl^- of 0.25 % for broilers during the 1-21 day period. In their study the authors observed better performances for D.E.B. values from 250 to 315 mEq/kg. For the later period of growth (21-42 days) Borges ***&* *al.*** (2003) suggest an optimal DEB value of 220 mEq/kg for growing broilers. Indeed, in practical diets sodium bicarbonate, a sodium source chloride free is usually used to balance salt Na^+ supply to maintain the DEB value over the critical levels of 200 mEq/Kg. However, other Na^+ sources chloride free, such as sodium sulphate, could be used to balance the feed sodium level and maintain the DEB value. On the other hand, in the field, sodium bisulphate ($NaHSO_4$) is used in poultry litter treatment against ammonia production. The main objective of this study is to compare the effect of two diets, one formulated with sodium bicarbonate and the other formulated with sodium sulphate, on growing broiler performances for a 42 day growing period. Litter ammonia emission will be measured at the end of the growth period to evaluate the influence of the various sodium sources on litter ammonia production.

In a standard corn, wheat, soybean meal diet, different sodium sources (Bicarbonate vs Sulphate) were compared on an equivalent Na and DEB values: 0.28- 0.22-0.20 % and 290-240-220 mEq/kg for Starter, Grower and Finisher respectively. 600 Ross male broilers chicks were allocated in 12 floor pens (6 for each treatment) and fed ***ad libitum*** for a 42 day period.
Growth performances and mortality were measured between 0-14, 15-28 and 29-42 days of age.
Water consumption and litter ammonia production were also measured. The trial was performed at the CERN, Adisseo France SAS, Commentry, France.

Table 1 Main raw materials and mineral compounds in experimental diets.

	Sodium bicarbonate diet			Sodium sulphate diet		
Raw material %	**Starter**	**Grower**	**finisher**	**Starter**	**Grower**	**finisher**
wheat	10,00	10,00	7,60	10,00	10,00	7,60
corn	41,25	46,10	54,40	41,25	46,10	54,40
Soybean meal	37,00	31,70	26,30	37,00	31,70	26,30
Soya seeds	2,00	1,50	1,30	2,00	1,50	1,30
Vegetal oil	5.2	6,40	6,60	5.2	6,40	6,60
salt	0.315	0.265	0.237	0.315	0.265	0.237
Sodium bicarbonate	0.514	0.374	0.347	0	0	0
Sodium sulphate	0	0	0	0.434	0.316	0.293

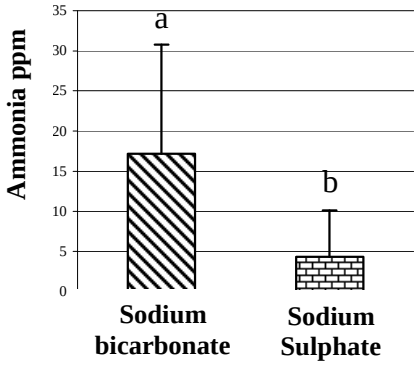
The mortality rate observation, carried out throughout the growth period, shows no significant difference between the two diets. Table 2 shows that the different diets encourage no significant effect on weight gain or FCR. This result shows clearly that replacing sodium bicarbonate by sodium sulphate does not affect growth performance during the 1-42 day period. Water consumption results show no differences between the two experimental diets. At the end of the 42-d period, 12 animals (1 per pen) were killed and autopsied. No adverse effects of sodium sulphate vs bicarbonate were observed in this trial.

The ammonia production (figure 1) of each pen was measured. The results obtained at 41 days, showed a significant reduction of ammonia release with sodium sulphate compared to sodium bicarbonate. One hypothesis for the reduction of ammonia production with sodium sulphate concludes that: sulphate released with the excreta has a lowering effect on litter pH, or on the other hand, part of the excreted sulphate could chemically interfere with litter ammonia and transform it into ammonium sulphate.

Table 2 Growth performances of broilers

	Bicarbonate diet	Sulphate diet
Weight gain D1-D14	273 ± 11,8	281 ± 12,6
FCR J1 - J14	1,443 ± 0,057	1,464 ± 0,018
Weight gain D14-D28	895 ± 14,2	913 ± 35,2
FCR J14 - J28	1,617 ± 0,020	1,616 ± 0,028
Weight Gain D28-D42	1346 ± 25,9	1339 ± 83,8
FCR D28-D42	1,923 ± 0,034	1,913 ± 0,029

Figure 1 Litter ammonia production



Using sodium sulphate instead of sodium bicarbonate has a noteworthy economic impact on the cost of the diet. At the level used for this trial and for an average price basis of 110 €/T for sodium sulphate, 200 €/T for sodium bicarbonate and 80€/T for salt, the difference in feed cost is 0.54 €/T, 0.48 €/T and 0.35 €/T respectively for starter, grower and finisher diets.

In conclusion using sodium sulphate instead of sodium bicarbonate to adjust sodium requirement has no negative effect on growth performance and reduces significantly the litter ammonia production. Moreover sodium sulphate gives an economical advantage compared to sodium bicarbonate.

References

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