Effect of sodium source without chloride

Poultry producers, who switch the source type of sodium, can make feed cost savings whilst optimising performance. Some trials are discussed here.

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All poultry feeds need to be supplemented with sodium, an element essential for many physiological functions. This is generally provided by salt plus a chloride-free source of sodium such as: sodium bicarbonate, sodium carbonate or sodium sesquicarbonate. An alternative and cost-effective chloride-free source of sodium is available to poultry producers in the form of sodium sulphate. Producers can save money on the cost of sodium addition; while managing dietary electrolyte balance (DEB) to support broiler performance and litter quality.

Formulation considerations

It is commonly accepted by nutritionists that the physiological ratio between chloride and sodium is below one. Hence, it is important to use a chloride-free source of sodium and reduce salt to maintain this ratio. This has the effect of increasing the DEB around an optimal value of 240-250 mEq/kg avoiding an imbalance in the acid base equilibrium. Many feed manufacturers worldwide already use sodium sulphate, as a sodium source without chloride. The product contains 32% sodium, a higher concentration than sodium bicarbonate or sodium sesquicarbonate. Therefore, poultry producers will reduce the cost of sodium without chloride in the diet, using a FAMI-QS certified product. Compared to sodium bicarbonate or sodium carbonate, sodium sulphate has a much lower acid binding capacity meaning that using sodium sulphate limits the dietary buffering effect in the upper digestive tract. A lower feed buffering capacity improves protein digestibility and increases efficacy of any organic acid used.

Replacing sodium bicarbonate

A scientific study was carried out last year at the internationally renowned Schothorst Feed Research in the Netherlands. The objective was to assess the effect of replacing sodium bicarbonate by sodium sulphate on the performance of broilers fed a commercial European type diet. The trial also measured litter and faecal quality parameters, to evaluate the effect on health and welfare of birds. The feed formulation was based

PHOTO: SHUTTERSTOCK

Producers can save money on the cost of sodium addition, while supporting broiler performance and litter quality.

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The use of sodium sulphate significantly reduces litter ammonia emissions compared to sodium bicarbonate.

on the substitution of sodium bicarbonate by sodium sulphate (AdiSodium) maintaining DEB value from 230 to 250 (mEq/kg) among the four rearing phases between 0 to 37-day old. Sodium sulphate and sodium bicarbonate treatments were equivalent in terms of body weight gain, feed intake, Feed Conversion Ratio (FCR) and European Poultry Efficiency Factor (EPEF) (*Figure 1*). Whilst the litter and faeces moisture levels were similar, there was a numerical reduction in faecal pH (*Table 1*). Interestingly, at 35-day old, the sodium sulphate treatment group exhibited significantly lower litter pH and food pad lesion score than sodium bicarbonate group. When the litter was analysed, sulphate levels were twice as high in the sodium sulphate treatment (*Figure 2*). It is therefore presumed that if the sulphate ions were found in the litter they were not absorbed in the gut. Consequently, they cannot contribute to the anion-cation balance of the bird. Confirming that sodium sulphate improves DEB and SO4 does not get involved. The authors concluded that sodium sulphate is a safe, efficient and cost-effective source of chloride-free sodium. In other trials on broilers, where sodium bicarbonate was replaced by sodium sulphate in broiler diets, there were also no significant differences between weight gain, feed intake or Feed Conversion Ratio at 42 days of age. Similarly, no effect on water consumption was observed, or any adverse effects on litter quality. Another point that was observed in one broiler trial was a reduction of ammonia emissions from 16.0 to 4.5 ppm, along with a reduction in litter pH. The same formulation principles have been applied in other trials to diets for laying hens and same conclusions were drawn. In a trial, the effects of a dietary treatment combining salt and sodium bicarbonate and another diet with salt and sodium sulphate were compared. No treatment difference on laying performance or egg shell quality was identified. The aim was also to disprove the supposition that sodium sulphate has a laxative effect when used as sodium source to balance DEB. In this purpose, a last dietary treatment was performed with twice the dose of sodium sulphate needed and, even in this condition, there was no effect on either faecal dry matter or excreta score of laying hens.

Effect on ammonia emissions

Two hypotheses have been put forward to explain why the replacement of sodium bicarbonate with sodium sulphate reduces ammonia levels. The first is that the sulphate reduces

Table 1 – Litter and faecal quality at 35 days of age.

	Sodium bicarbonate	Sodium sulphate
Feacal moisture (g/kg)	777	773
Litter moisture (g/kg)	511	533
Faecal pH	6.29	6.19
Litter pH	6.73[a]	6.07[b]

Figure 1 - Broiler performance at 37 days of age.

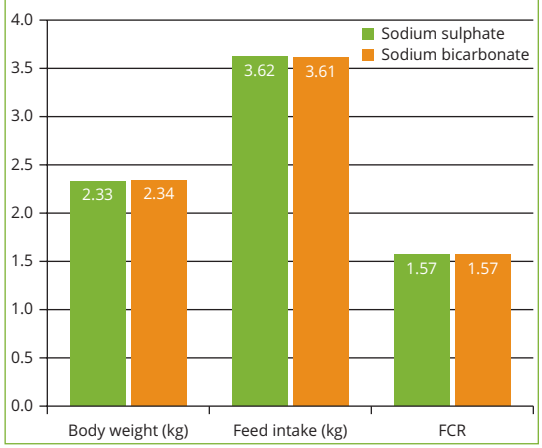
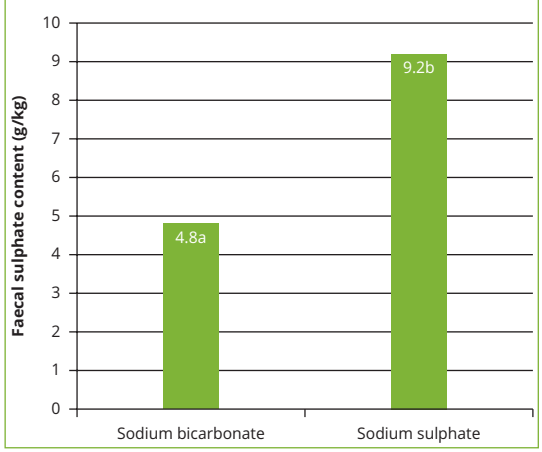


Figure 2 - The sulphate content of faeces.



litter pH (<8) that would reduce the ammonia producing bacteria growth rate. It is known that increasing DEB in broilers increases litter pH but replacing sodium bicarbonate with sodium sulphate results in lower litter pH and hence ammonia emissions. The second idea put forward is that part of the sulphate excreted by the birds chemically interacts with ammonia present in the litter. That it transforms it into ammonium sulphate, hence reducing the release of ammonia from the litter, instead binding it within and reducing litter pH.

Cost implications

It can be concluded that sodium sulphate can replace other sodium sources in diets for broilers without any detrimental effects on performance. In so doing, there is the potential to reduce the cost of sodium addition to feed. This offers producers a significant economic advantage allowing to get the benefits of an improved DEB. The use of sodium sulphate significantly reduces litter ammonia emissions compared to sodium bicarbonate. This finding has benefits for both the health and performance of the birds, as well as the working conditions of stock people. At the same time, any concerns of the effect on faecal consistency or litter quality have been deleted. Overall the use of sodium sulphate offers poultry producers a large scale of opportunities without compromising performance.

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Dietary electrolyte balance

DEB plays an important role in body's water management and the acid:base regulation of blood. An adjusted electrolyte balance allows maintaining blood buffer system. The Dietary Electrolyte Balance is calculated using the amount of electrolytes expressed as g/kg for each ingredient as follow: *DEB =Na + K – Cl. (mEq/kg)*. If levels of sodium (Na+) and potassium (K+) ions are too high in the diet then too many H+ ions will be pumped out of the blood. Conversely, the addition of chloride (Cl-) will reduce the blood HCO3- levels, leading to acidosis, whilst at the same time reducing the blood buffering capacity. An excess of chloride, compared to sodium, should therefore be avoided. Any imbalance will increase the metabolic acid load and initiate a regulatory process by the bones lungs or kidneys. This in turn is energetically expensive, requiring nutrients that would otherwise be used for growth etc. It is therefore recommended that DEB be a formulation matrix constraint, along with ideal levels of each electrolyte.