# TNIBetain improves broiler chicken performance and carcass quality under heat stress conditions

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**In an experiment with 300 male and 300 female Ross 308 broiler chickens housed in floor pens, the effect of betaine (TNIbetain) on bird performance and carcass and meat quality was studied. The experiment included 3 treatments. Treatment 1 included feeds adequate in methionine and cystine according to CVB (1996) that contained in total 2.4 g/kg choline. In treatments 2 and 3, 1 and 2 g/kg betaine was added to these feeds respectively. Treatments were applied from 0 to 40 days of age. Heat stress was introduced by increasing temperature to 35 °C during 10 hours of the day. During the rest of the day, temperature was gradually decreased to 25 °C.**
**The addition of 1 and 2 g/kg betaine to the feed improved feed conversion ratio from 1.322 to 1.274 and 1.256 respectively from 0 to 14 days of age (P=0.0153) and body weight at 40 days of age from 2093 g to 2116 and 2158 g respectively (P=0.0376). The addition of 1 and 2 g/kg betaine to the feed increased breast meat percentage in male chickens from 17.44 to 18.21 and 18.30 respectively (P=0.0350). It was concluded that betaine can improve broiler chicken performance significantly during heat stress.**

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**Keywords**: broiler chickens; betaine; heat stress

## Introduction

Betaine has been used for many years in poultry feeds. It basically has two metabolic functions: betaine can serve as a methyl donor and it can help maintaining cellular osmolarity. In particular the latter function might be associated with more pronounced positive effects on performance in coccidiosis challenged birds (Tiihonen et al., 1997; Waldenstedt et al., 1999; Klasing et al., 2001) and in chickens housed under heat stress conditions (Zulfiki et al., 2004) compared to non-challenged birds. According to Gous and Morris (2005), temperatures that optimise performance of broiler chickens tend to decrease through the years due to an increased growth rate and heat production. This might indicate that broiler chickens become more susceptible to heat stress. In order to test the effect of betaine on the performance of heat-stressed broiler chickens, an experiment was carried out.

## Material and methods

The experiment included in total 300 male and 300 female Ross 308 broiler chickens. Birds were housed in 24 floor pens of 2.5 x 1.6 m with 25 birds per pen. Each pen was equipped with one tube feeder and 4 nipple drinkers. The broiler chickens were subjected to three different treatments. Treatment 1 was the control group, in which feeds without added betaine were provided. The composition of these feeds is shown in Table 1. Feeds were adequate in digestible methionine and cystine according to CVB (1996). In treatments 2 and 3, 1 and 2 g/kg betaine ([TNI]betain, Trouw Nutrition International, Tilburg, The Netherlands) was added to the feeds respectively through the vitamin and mineral premix. Each treatment included 8 replicates with 1 treatment pen per block. Light was provided 24 hours per day from day 0 to 3 and 20 hours per day thereafter. Temperature started at 33 °C ad day 0 and was increased to 35 °C from day 2 on during 10 hours per day, starting at 8.00 hours. During the rest of the day, temperature was kept on 30 °C from day 2 to 7 and was gradually decreased to 25 °C from day 7 to 14. Thereafter, temperature was maintained at 25 °C. Birds were vaccinated against infectious bronchitis, Marek´s disease, Newcastle disease and infectious bursal disease according to recommendations of a broiler chicken integrator (SADA, Tres Cantos, Spain). Feed and water were provided for ad libitum consumption.

Live weight and feed intake of birds was determined per pen at day 0, 14, 31 and 40. Mortality was recorded daily. At 40 days of age, 10 birds per replicate were slaughtered in order to determine carcass yield and the amount of breast meat and abdominal fat. Slaughter procedures of a broiler chicken integrator were followed (SADA, Tres Cantos, Spain).

Data were subjected to analysis of variance (GLM procedure of SAS 8.2, SAS Institute, 2001). The statistical model included block (replicate) and treatment as factors. Significant differences among treatments were detected by a least significant differences procedure (Snedecor and Cochran, 1967). Differences were considered significant at P≤0.05.

**Table 1 Composition and calculated contents of the basal experimental feeds without added betaine.**

| Period | Starter, day 0-14 | Grower, day 15-31 | Finisher, day 32-40 |
|---|---|---|---|
| Corn | 25.000 | 10.193 | 6.820 |
| Wheat | 31.767 | 54.999 | 59.999 |
| Soybean meal, 44 % cp | 33.648 | 25.991 | 23.995 |
| Soybean oil | 5.613 | 5.658 | 6.152 |
| Calcium carbonate, fine | 1.250 | 0.925 | 0.908 |
| Mono calcium phosphate | 1.426 | 0.827 | 0.725 |
| Sodium chloride | 0.313 | 0.278 | 0.275 |
| Sodium bicarbonate | 0.070 | 0.123 | 0.128 |
| Premix, vitamins and trace elements | 0.500 | 0.500 | 0.500 |
| DL-methionine | 0.121 | 0.090 | 0.076 |
| L-lysine HCl | 0.151 | 0.241 | 0.247 |
| L-threonine | 0.041 | 0.075 | 0.074 |
| Avizyme 1300 | 0.100 | 0.100 | 0.100 |
| Total | 100.000 | 100.000 | 100.000 |
| Calculated contents, g/kg | | | |
| $AME_{broilers}$[1)], kcal/kg | 2850 | 2950 | 3000 |
| Moisture | 94.2 | 86.2 | 83.9 |
| Crude protein | 216.8 | 206.6 | 202.5 |
| Crude fat | 74.1 | 71.9 | 76.1 |
| Crude fibre | 35.6 | 35.2 | 34.9 |
| Starch | 364.4 | 397.9 | 403.7 |
| Digestible lysine | 10.5 | 10.0 | 9.7 |
| Digestible methionine | 4.8 | 4.4 | 4.2 |
| Digestible methionine+cystine | 7.7 | 7.3 | 7.1 |
| Digestible threonine | 6.8 | 6.5 | 6.3 |
| Digestible tryptophan | 2.2 | 2.1 | 2.0 |
| Digestible arginine | 12.3 | 11.0 | 10.6 |
| Digestible isoleucine | 7.7 | 7.0 | 6.8 |
| Digestible valine | 8.4 | 7.8 | 7.6 |
| Calcium | 9.0 | 6.5 | 6.2 |
| Phosphorus | 7.0 | 5.6 | 5.3 |
| Retainable phosphorus | 4.1 | 3.0 | 2.8 |
| Sodium | 1.5 | 1.5 | 1.5 |
| Potassium | 9.4 | 8.3 | 7.9 |
| Chloride | 2.5 | 2.5 | 2.5 |
| Choline | 2.4 | 2.4 | 2.4 |

[1)] calculated according to CVB, 2005

## Results and discussion

The addition of betaine to the feed resulted in a small increase in weight gain and in a small reduction in feed intake in the period from day 0 to 14, which provided a significant reduction in feed conversion ratio (Table 1). In the period from day 0 to 40, the addition of betaine resulted in an increase in final body weight and feed intake. The differences in body weight and weight gain was significant between treatments with 0 and 2 g/kg betaine added. The highest amount of betaine added tended to improve feed conversion ratio (P=0.065) as compared with the control group. No differences in mortality were observed among treatments.

The observed effects of betaine on broiler chicken performance found are in line with findings of Lundeen (2000) and Zulfiki et al. (2004). Zulfiki et al. (2004) reported a more clear reduction of 16 to 39 % in mortality when betaine was added to the feed than in the present experiment. The results of the present experiment and those reported in literature indicate that betaine can improve performance in heat-stressed broiler chickens.

The addition of betaine to the feed did not provide significant differences in carcass percentage and abdominal fat (Table 3). A significant interaction was observed for breast meat between the amount of betaine added and sex. In male broiler chickens, the addition of betaine to the feed resulted in a significant increase in breast meat percentage (P=0.0350), while this increase was absent in female chickens.

Although betaine has been reported to reduce fat deposition in non-challenged birds (Saunderson and MacKinlay, 1990; Hassan et al., 2005), this does not seem to be the case in heat-stressed broiler chickens, as was found by Zulfiki et al. (2004) and was observed in the present experiment. The improvement in breast meat percentage found in the present experiment is in line with results obtained with heat-stressed chickens reported by Lundeen (2000) and with results of non-challenged birds reported by Rostagno and Pack (1996) with and without added DL-methionine, Schutte et al., (1997), Esteve-Garcia and Mack (2000) and MacDevitt et al. (2000). The results obtained in the current experiment indicate that betaine can improve body weight and breast meat percentage under heat stress conditions.

**Table 2 Effect of added betaine on performance of heat-stressed broiler chickens from 0 to 40 days of age.**

| Betaine added, g/kg | 0 | 1 | 2 | P-value |
|---|---|---|---|---|
| *Day 0-14* | | | | |
| Body weight, g | 373.4 | 376.0 | 382.4 | 0.6931 |
| Weight gain, g/day | 23.86 | 24.03 | 24.51 | 0.6812 |
| Feed intake, g/day | 31.56 | 30.56 | 30.71 | 0.4239 |
| Feed conversion ratio | $1.322^{a}$ | $1.274^{b}$ | $1.256^{b}$ | 0.0153 |
| Mortality, % | 0.5 | 0.5 | 1.0 | 0.7815 |
| *Day 0-40* | | | | |
| Body weight, g | $2092.5^{b}$ | $2116.2^{ab}$ | $2158.0^{a}$ | 0.0376 |
| Weight gain, g/day | $51.30^{b}$ | $51.92^{ab}$ | $52.97^{a}$ | 0.0365 |
| Feed intake, g/day | 85.07 | 86.81 | 86.70 | 0.2207 |
| Feed conversion ratio | 1.660 | 1.673 | 1.639 | 0.1695 |
| Mortality, % | 10.5 | 10.5 | 9.5 | 0.9615 |

**Table 3 Effect of added betaine on slaughter quality of heat-stressed broiler chickens.**

| Sex | Male | | | Female | | | P-value | | |
|---|---|---|---|---|---|---|---|---|---|
| Betaine added, g/kg | 0 | 1 | 2 | 0 | 1 | 2 | Betaine | Sex | Interaction |
| % carcass | $80.70^{a}$ | $80.65^{ab}$ | $80.53^{ab}$ | $80.13^{ab}$ | $79.88^{b}$ | $80.17^{ab}$ | 0.8854 | 0.0114 | 0.7520 |
| % breast meat | $17.44^{c}$ | $18.21^{b}$ | $18.30^{b}$ | $18.98^{a}$ | $18.67^{ab}$ | $18.70^{ab}$ | 0.3570 | <0.0001 | 0.0145 |
| % abdominal fat | $1.83^{b}$ | $1.97^{ab}$ | $1.88^{ab}$ | $2.07^{a}$ | $2.07^{a}$ | $2.04^{ab}$ | 0.5932 | 0.0105 | 0.6795 |

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