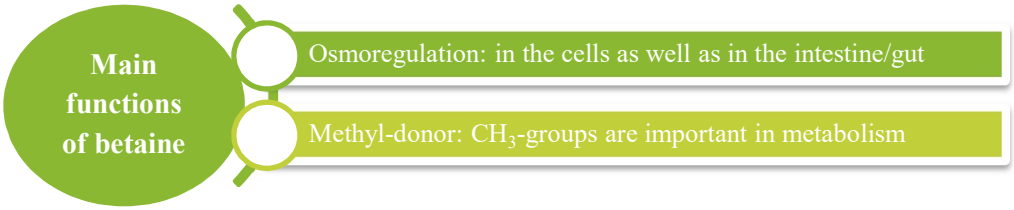
BETAINE in poultry diets

a versatile nutrient to tackle heat stress

As environmental temperature increases, birds start panting to lose heat: increasing respiration helps to evaporate more water and has a cooling effect. However, this results in more water loss from the cells. In order to maintain the water balance in the cells during heat stress an energy demanding process is necessary: the Na^+/K^+ pump across the cell membranes. Due to its osmotic function, **feeding betaine can help to regulate water retention in the cells**, therefore the cells rely less on the Na^+/K^+ pump activity which in turn saves energy within the cell and **dehydration can be prevented**.



There are several betaine products on the market: either betaine HCl or anhydrous betaine. Anhydrous betaine has several advantages compared to the HCl form:

- It is a bipolar molecule, therefore it dissolves in water more rapidly and fully compared to the chemically produced betaine HCl.
- Does not contain any redundant substances. In contrast, betaine HCl from different origin can contain high levels of chloride and trimethylamine. Excess supply of chloride can negatively affect the ionic balance and osmolarity, and trimethylamine is associated with increased egg taint in poultry.

Therefore, in case the animals are in a challenged state, such as during heat stress, anhydrous betaine supplementation is recommended.

INVE Belgium offers **INVEBET**, a liquid form of natural anhydrous betaine, containing min. 30% of betaine derived from sugar beet.
In addition, for layers **BETALAY** is also available which is a liquid betaine source combined with lactic acid.

Some experimental results from the scientific literature using anhydrous betaine in broiler and layer diets are reported below.

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Betaine for Broilers under heat stress

In a study Ross 308 chicks from d2-40 were kept at 35 °C for 10h every day (Eissen J. and Enting, 2007). **Inclusion of anhydrous betaine (1000ppm, 2000ppm) resulted in**

- **higher bodyweight**
- **lower feed conversion and**
- **higher breast meat yield**

compared to a diet without betaine supplementation. Increasing betaine level to 2000 ppm in the diet also **reduced mortality** (Table 1).

Table 1. Effect of betain in heat-stressed broilers (d2-40)

Performance traits	Added betaine		
	0 ppm	1000 ppm	2000 ppm
Bodyweight (g)	2093[b]	2116[ab]	2158[a]
FCR-2100 gram	1.663[a]	1.677[a]	1.616[b]
Mortality %	10.5	10.5	9.5
Breast meat %	17.4	18.2	18.3

Source: Eissen J. and Enting H., Feed Mix Vol. 15 no. 5 , 2007.

- The osmolytic function of betaine contributes to maintain gut integrity: better water balance in the intestinal cells, therefore better utilization of nutrients
- Better water retention in the body and lower mortality

The positive effects of feeding anhydrous betaine has also been shown in slow-growing broilers (Attia *et al.,* 2009). Slow growing broilers were kept for 3 successive days per week under heat stress at 38±1.4°C (49±2% relative humidity) without any betaine supplementation or with 500ppm or 1000ppm anhydrous betaine in the diet. Performance of heat stressed birds was compared to birds kept in standard conditions which served as the positive control treatment.

Results showed that **supplementation of anhydrous betaine could increase feed intake which improved bodyweight gain** compared to the negative control treatment where birds had to tackle heat stress without any additional dietary betaine supplement (Table 2).

Table 2. Effect of betaine in heat-stressed slow growing broilers (d21-84)

Performance traits	Standard conditions	Heat-stressed		
	Control + 0ppm	Control – 0ppm	Betaine 500 ppm	Betaine 1000 ppm
Bodyweight gain (g)	1123.3	996.6	1050.9	1100.4
Feed intake (g/day)	4032.7	3836.8	3949.6	4065.9
FCR	3.590	3.851	3.758	3.673

(Attia et al., 2009)

Rectal temperature of birds also decreased (41.9 °C vs 43.2 °C) compared to negative control. Respiration rate, to lose heat via evaporation, was also slower, it was reduced from 78.3 to 63.9 breaths/minute.

Betaine for Laying hens under heat stress

In layers heat stress can lead to respiratory alkalosis. As birds increase their respiration rate blood CO_2 level decreases and blood pH increases. Therefore, the activity of the enzyme carbonic anhydrase – which is responsible for the transfer of carbonate ions from blood to the shell gland – is reduced. Ultimately less carbonate ion will be available for shell formation and shell quality will be reduced.
Therefore, nutritional adjustments during heat stress in layers is of outmost importance. **Betaine anhydrous can help to ease the negative effects** of heat stress on the cells' metabolic functions however additional nutiritonal and management measures are also required to maintain shell quality (e.g.: feeding $NaHCO_3$).

The effect of anhydrous betaine was tested with layers kept under chronic heat stress for 3 days a week (38 °C ± 1) between 32-48 wk of age (Attia *et al.,* 2016). Results showed that **addition of anhydrous betaine had the potential to restore performance of hens compared to the negative control treatment undergoing heat stress without any betaine in the diet.** Higher laying % and egg mass, slightly lower FCR were observed in the betaine treated group. In addition mortality was reduced.

Table 3. Effect of betaine in heat-stressed laying hens (32-48 wk)

	Standard conditions	Heat stressed	
	Control + 0ppm	Control – 0ppm	Betaine 1000ppm
Laying rate %	68.0	60.5	65.5
Egg mass g	34.3	29.9	33.3
FCR	3.95	4.29	3.99
Mortality %	0	1.5	0

Source: Attia et al. (2016)

Recommendations for Poultry

In case of high environmental temperatures the **supplementation of 1000ppm anhydrous betaine** is recommended. This level can be supplied by the **inclusion of 2,87 kg/T INVEBET** in the diet.

For further information regarding specific recommended betaine levels in your country and the additional benefits of betaine on energy utilization, carcass quality and on betaine's function as a choline cloride replacer, please contact the resposible distributor of INVE Belgium.

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