

Betaine – a valuable additive in pig production



Betaine is a widely distributed, naturally occurring compound in animals and plants. As a feed additive, available in anhydrous or hydrochloride form, it can be supplemented to diets for livestock for a variety of purposes. Although most research on supplementation of feed with betaine is focussing on poultry, also in pigs different effects are described. This article gives an overview of the roles of betaine as a feed additive on performance, carcass quality and other aspects in pig production.

The double function of betaine

The biological function of betaine exists of a double role: methyl donor and protective osmolyte. As an osmolyte, betaine regulates the hydration status of cells and tissues. This alleviates osmotic stress and protects cells against osmotic inactivation. As a methyl donor, betaine plays an important role in methylation reactions. These reactions are essential for the synthesis of several metabolically active substances such as creatine, carnitine and phosphatidylcholine. Also expression of genes is regulated by methylation of DNA. Because the methyl groups cannot be synthesized, animals need to receive them in their diet in high enough concentration to fulfil their needs. For this purpose, betaine may replace other methyl donors such as choline in the diet. Since betaine (hydrochloride) is less corrosive and less hygroscopic than choline chloride, replacement also gives practical advantages.

Betaine and carcass modification

Both in fat and in protein metab-

olism, betaine has an influence. As a strong methyl donor, betaine improves synthesis of carnitine and phosphatidylcholine, involved in fatty acid oxidation and fat transport through the body. By converting homocysteine to methionine, betaine increases methionine concentration for the animals (protein) metabolism and also extra glycine comes available after betaine loses its third methyl group. Additionally to this participation in protein and lipid metabolism, betaine could promote growth of pigs by changes in growth hormone levels.

As a result, dietary betaine can decrease backfat and increase carcass leanness. This is called the lipotropic effect of betaine and is not only seen in pigs, but also in broilers and even in humans. Higher dressing percentage is often favoured by customers, but brings also economically an advantage. The alteration of body composition (less subcutaneous fat and lower carcass fat percentage) can depend on genetics and also on synergistic interactions with other nutrients like conjugated linoleic acid. Some authors indicate that the effect of betaine is greater when added to diets containing low concentrations of energy.

Reproductive performances

Both for sows and boars, beneficial effects of betaine on reproductive performances are described. The temperature in the farrowing stable is often above the comfort zone of sows, in favour of the new born piglets. Betaine for lactating sows reduces the negative impact of heat,

observed by a better feed intake of the lactating sow. This results in less need to mobilize body reserves, accordingly lower body weight loss and a reduced weaning to oestrus interval are described. In some studies an improvement of litter weight at weaning was also found.

When supplemented to gestating sows, betaine resulted in an increased number of piglets born, especially in sows of third parity onwards. For boars, a tendency for increased total sperm in ejaculates was seen with intake of betaine during summer.

Heat stress protection

Accumulated in high concentrations in the cytoplasm of cells, betaine prevents osmotic pressure on cell membranes. Osmotic stress may be caused by disease, malnutrition or inadequate environmental conditions such as high temperature. Accumulation of betaine permits metabolic activity under conditions that would normally cause impairment of cell functions. This stabilising influence on tissue metabolism is particularly important within the digestive tract. A more resistant gut epithelia and a persistent production of cellular enzymes, ensure the digestibility of nutrients. Next to the protective working of betaine on animals cells and tissues during heat stress, betaine reduces heat production. Consequently, lower rectal temperatures were seen in betaine supplemented sows.

Effects on growth

Even though effects are variable, there are a lot of studies showing the performance enhancing effect of betaine. When incorporated into grower or finisher diets, betaine has been reported to improve weight gain and feed conversion up to 15% and 8% respectively. As for many feed additives, feeding level and diet composition can influence observed benefits. For betaine it has been shown feed efficiency of pigs housed under suboptimal hygienic conditions is improved. By control over metabolic processes the energy needed for maintenance can be reduced, resulting in more energy from the

Usage of betaine in the different swine categories:

Piglets	<ul style="list-style-type: none"> – Replacement of choline chloride in the feed – Improve performance – Protect gut and improve gut morphology – Supply methyl groups (e.g. for creatine synthesis)
Grower/Finisher pigs:	<ul style="list-style-type: none"> – Replacement of choline chloride in the feed – Improve performance (weight gain, feed efficiency) – Improve carcass characteristics (less back fat, lower carcass fat and higher dressing %) – Heat stress protection
Sows	<ul style="list-style-type: none"> – Heat stress protection – Reproductive performance (reduced WEI, more total piglets born, lower body condition loss)
Boars	<ul style="list-style-type: none"> – Heat stress protection – Reproductive performance

diet available for production instead. Moreover, an improvement in digestibility of dry matter and fibre can further improve performance. An interesting indication for weaning piglets is the protective effect of betaine on the gut reported in chickens. Such extra stabilising effect on gut morphology can be a good help for a successful weaning process. Neonatal piglets also have a high requirement for creatine synthesis in their early development. Partially this is delivered by creatine in the colostrum, but 77% is produced by de novo synthesis, which requires methyl groups. Supplementation of betaine will provide the most efficient contribution. **References are available upon request (maele@orffa.com).**

Effect of betaine on carcass quality in pigs

Category	Betaine inclusion (%)	Effects	Reference	
Barrows 36-64 kg	0,13-0,5	Carcass fat	↓	Fernandez-Figares et al., 2002
		Fat depth	↓	
		Carcass protein	↑	
Barrows 83-116 kg	0,13	Fat depth	↓	Lawrence et al., 2002
Barrows, gilts 60-115 kg	0,13-0,5	Carcass length	↑	Matthews et al., 2001
		Lean percentage	↑	
		Backfat thickness	↓	
Pigs	0,2	Backfat thickness	↓	Urbanczyk, 1997
Barrows, gilts 20-65 kg	0,15	Lean percentage	↑	Wang & Xu, 1999
		Backfat thickness	↓	
Pigs, > 60 kg	0,1	Fat percentage	↓	Wang et al., 2000
		Lean percentage	↑	
Pigs, 25-110 kg	0,08-0,18	Fat percentage	↓	Yu et al., 2001
		Lean percentage	↑	



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osmotic PROTECTION
during
HEAT STRESS



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- Proven efficacy in several animal species
- Methyl donor, replacing choline and partially methionine
- Effective in heat stress periods

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