

Betaine for increased breast meat yield in turkeys

Betaine plays an important role in the use of specific feed ingredients and the health of the birds. As a result it contributes to the performance and the yield of birds.

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In North America and Europe, breast meat is a favoured cut for consumers and is therefore of significant economic value for the poultry industry. Modern poultry strains have been selected for increased carcass yield, particularly with respect to the breast muscle. To gain full advantage of this genetic improvement, poultry nutritionists formulate diets designed to provide the birds with a good nutrient profile as well as nutrient digestibility. Historically, nutrient parameters such as crude protein, essential amino acids and the amino acid to energy ratio are known to affect the ability of the bird to accrete carcass protein. More recently, betaine has been shown to have a similar effect.

Betaine functions in the body as an osmolyte to help defend against dehydration, it is also a methyl group donor which supports synthesis of many components such as protein, DNA/RNA and the neurotransmitter epinephrine. A natural betaine that has been extracted from sugar beet and subsequently purified, Betafin® has been shown to reduce lesion scores, increase nutrient digestibility and intestinal tensile strength in chickens with a history of coccidia-challenge. Betaine also allows the commercial broiler producer to economically optimise usage of methionine and choline through its function as a methyl donor function.

The importance of water

Water is frequently overlooked as a nutrient vital for the growth of farm animals, even though it is a large component of the meat product ultimately sold to the consumer. Muscle from market age turkeys and broilers is approximately 74% to 75% water (USDA Nutrient Database for Standard Reference, 1999). Water has a very basic function in cells of all types in addition to it being the matrix that bathes and supports the cell's organelles. It is the key nutrient regulating cell metabolism, so a slight increase in water content of a cell increases that cell's growth related activity while loss of water from the cell decreases growth. In



Adding betaine to turkey feed increases the breast meat yield in turkeys

addition, a large portion of energy within the body is used to keep a relatively constant water volume within cells. Estimates of 30 to 60% of the maintenance energy used within the visceral organs is associated with the sodium-potassium ATPase pump. This pump helps maintain water balance in cells and is particularly important in the absences of osmolytes such as betaine. The advantage of the osmolyte betaine versus the sodium-potassium ATPase pump is that less energy is needed to accumulate betaine within a cell. In addition, betaine is safe for the cell to accumulate to high levels whereas high levels of electrolytes can adversely affect cell metabolic activity. Specifically, betaine has been shown to alleviate dehydration of cells during osmotic stress and is accumulated by aquatic species during osmotic stress for the same purpose. In broilers, betaine has been shown to increase body water retention during heat stress, a factor important in the ultimate survival of the bird during heat stress, and to help improve performance of broilers given a coccidia challenge.

Turkey breast meat yield

In trials conducted in the USA, Mexico and Canada a 2% average improvement in breast meat yield was observed in broilers fed diets supplemented with betaine. Recent research conducted in the USA showed that betaine increased turkey breast meat yield in market age toms by an average of 3% (*Figure 1 and Table 1*). The diets fed consisted of corn, soybean

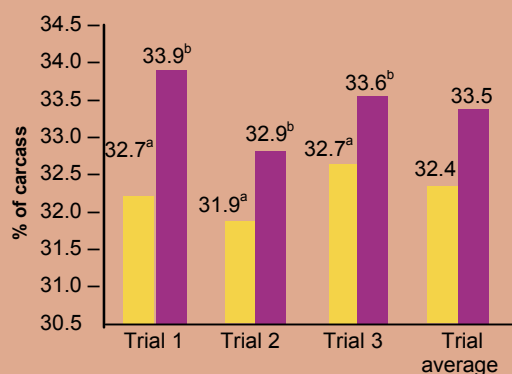
meal, canola meal and meat meal or meat byproduct meal as the primary ingredients. Amino acid supplementation was made according to commercial practice in the USA. Trial 1 was conducted in conjunction with a US turkey producer while trials 2 and 3 were conducted in University facilities. Betafin® BCR (97% betaine) was used in trial 1, while Betafin® S6 (91% betaine) was used in the trials 2 and 3. In all the trials 0.1 % of the product was added to the diets.

Better absorption properties

Established effects of betaine supplementation include better absorption of protein, lysine and methionine in stressed birds as well as the formation of methionine from the amino acid homocysteine in the liver. Significant increases in blood methionine, serine and glycine have also been noted in goats fed diets containing betaine. In non-stressed pigs fed a diet containing betaine, serum levels of serine and valine increase significantly while methionine and glycine tend to increase. Plasma homocysteine level decreases in birds fed an adequate diet supplemented with betaine; this would be expected if betaine is being used as a methyl group source by the liver to convert homocysteine into methionine. Thus, betaine may affect the blood amino acid profile through its osmolyte activity in helping alleviate dehydrating stresses in the intestine as well as through its methyl donating role.

However, given the metabolic effects of osmolytes on cells, it is possible that

Figure 1. The effect of Betaine (Betafin,) on breast meat yield in market age turkey toms



^{a,b} means without a common letter differ at P<0.05

Control Betaine

Table 1, Weight and breast meat yield of tom turkeys supplemented with betaine (0 or 0.1% Betafin®)

	Age (weeks)	Treatment	Live weight at slaughter (kg)	Carcass weight (kg)	Breast (% of carcass)	Breast yield improvement (%) ¹
Trial 1*	22	Control	17.04	14.04	32.67 ^b	
		Betaine	16.92	14.41	33.92 ^a	3.83
Trial 2**	20	High energy	18.29	14.59	31.92 ^c	
		Low energy	18.39	14.53	32.40 ^b	
		Low energy + Betaine	18.36	14.53	32.87 ^a	2.98
Trial 3**	20	Control	19.86	15.61	32.71 ^b	
		Betaine	19.90	15.67	33.60 ^a	2.72
Average		Control	18.40	14.69	32.43	
		Betaine	18.39	14.87	33.46	3.33

^{a,b,c} means without a common letter within a study differ at P<0.05
 *supplemented from day of age to 22 weeks of age
 **supplemented from 5 to 20 weeks of age
¹ compared to control or high energy diet

betaine may affect the muscle cell itself. All body tissues can use betaine for its osmolyte activity, although only the liver can also use betaine as a methyl group source in many species. In farm animals, the intestine, liver and kidney will accumulate betaine, although relatively high levels of dietary supplementation of betaine are needed for it to be detected in tissues other than the intestine, liver and

kidney. Specifically, low levels of betaine can be detected in the muscle when broilers have been supplemented at a level of approximately 800 ppm betaine in their feed. The level associated with breast yield improvement is 1000 ppm. This suggests that part of the yield response may be related to the muscle itself. Given the known effect of osmolytes on improving growth functions of the cell,

it is possible that a portion of the yield effect may be related to a more growth-related mode in the muscle cell. However, it is important to note that the rate of muscle accretion is dependent on the profile of nutrients available to the muscle. Thus, intestinal and liver effects of betaine are also likely contributors to the yield effect noted in birds fed diets supplemented with betaine. |

Key Words:

Betafin (poultry), Betafin, betaine, turkey, breast yield, breast meat, osmolyte