Improving poultry carcass characteristics

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With increasing amounts of poultry meat sold as premium priced cuts, improving the yield of these cuts, such as breast meat, is one option available to the producer to increase profitability.

Improved poultry carcass characteristics such as lower fat content, higher percentage of breast yield and increased carcass yield in general, together with other factors such as meat tenderness, colour and juiciness, are factors which are becoming increasingly important to consumers, and consequently to meat packers and poultry integrators.

Modern poultry strains have been selected for carcass yields. To fully exploit the genetic potential of these birds, nutritionists have developed diets, which are of higher nutritive value, both in terms of nutrient density and digestibility.

Several nutrients, such as crude protein, essential amino acids and the amino acid to metabolisable energy ratio are known to affect carcass yield, by directly affecting protein synthesis.

In addition, some feed supplements, such as betaine, have also been shown to improve these carcass characteristics.

The following overview summarises some of the recent studies, which show that Betafin (betaine, Finnfeeds) has a role in improving breast and carcass yield in broilers and turkeys.

Natural betaine

Betaine is a naturally occurring substance found in a variety of plant and animal species.

Betaine works in the bird's metabolism. It acts as a methyl group donor for the synthesis of many important compounds, such as protein, DNA/RNA, nucleic acids and choline and also acts as an osmolyte, protecting cells and tissues from dehydration and osmotic inactivation.

Finnfeeds is the world's leading supplier of betaine, marketed in a highly purified form (up to 97%) as Betafin.

The osmolytic effects of Betafin and its influence on carcass characteristics

Betaine is an osmolyte. An osmolyte acts within cells, enabling cells to maintain the balance of water and ions, which is particularly important during osmotic stress.

Water cannot be directly bound or held by the cell. It will move according to the prevailing concentration gradient between the inside and the outside of the cell.

Maintaining the balance of water and ions within the cell is essential for cell longevity and therefore the health of the bird. As an osmolyte, betaine provides the cell with the opportunity to maintain and enhance water balance at not only a low metabolic cost, but in safe way without effecting metabolic activity, something which is not possible with inorganic ions like potassium and sodium.

At the intestinal level, Betafin, acting as an osmolyte, has been shown to increase the water holding capacity of intestinal tissues.

Numerous trials have shown the implications this has on reducing gut lesions associated with coccidiosis, improving nutrient uptake and enhancing gut strength.

Betafin therefore may be able to enhance carcass yield by enhancing the utilisation of nutrients (amino acids, energy & protein).

None of this is new or novel thinking, but what is often overlooked is the importance of water for laying down protein (carcass yield).

The importance of water in metabolism and its direct relationship on biochemical reactions such as protein synthesis has been reported before (Nilipoul, 1998, Sturkie, 1986).

Muscle tissue consists mainly of water, therefore the presence of water and the potential of the muscle cell to hold water will also govern the rate of protein synthesis and muscle growth.

Anything that can slightly increase the water content of the cell increases the function and growth of that cell. A trial conducted at Oklahoma State University, USA, showed that Betafin improved whole body water retention in broilers, something that will be important in alleviating heat stress but in the context of this discussion on yield demonstrates the effect of betaine at all tissue levels in maintaining water balance.

Further evidence of the yield effect of betaine being related to its action in muscle cells is that a low level of betaine occurs in muscle cells at the level of approximately 800 ppm of betaine in the feed and increases as the level of betaine in the feed is increased.

A level of Betafin at 1000 ppm is where significant yield effects due to Betafin are observed. It is therefore probable that a significant portion of the role of betaine is due to its effect in the muscle cell.

Up for proof?

A number of replicated trials conducted at research institutes over a range of production conditions such as differences in age of birds, diet types and rearing conditions, has shown that Betafin improves breast yield in broilers (Table 1).

Betafin has also been shown to increase breast yield in turkeys. While a number of studies have been conducted over the last three years, the most recent University of Minnesota trial is perhaps the best example of the potential and role of betaine on yield.

While the effect of methionine and TSSA is well established in their importance for protein deposition, the researchers wanted to look at varying levels of methionine and then add Betafin "on top" of those levels.

The results can be observed in Table 2 with the key finding of the researchers being that Betafin supplementation improved breast

Table 1. Betafin increases breast yield in broilers.

Country of trial	% improvement in breast yield Betafin vs control[1]
USA	+2.2
USA	+1.0
USA	+2.1
USA	+1.4
Mexico	+2.3
Mexico	+4.4
Canada	+2.1
Spain	+1.4
Average	+2.11

[1]Control = non-Betafin supplemented diet.
Reference: Finnfeeds' trial summary.

yield in turkeys at all methionine levels.

While the osmoregulatory property of Betafin clearly plays a role in improved carcass characteristics, it is important to evaluate the well-established methyl donor properties of Betafin. By providing the methyl groups for regeneration of methionine from homocysteine, Betafin gives the body the opportunity to use dietary methionine for protein synthesis (including muscle tissue deposition). This may offer some reformulation possibilities but the above study clearly highlights the main yield effect of betaine as being independent of methionine levels of the diet and thus it could be concluded due to its osmolyte role.

Table 2. Effect of Betafin on breast yield of 20 week old toms

Treatment	Carcass weight (kg)	Breast yield (%)
90% of NRC TSAA[2]	15.40	32.44^{c}
90% +Betafin[3]	15.63	33.44^{ab}
100% of NRC TSAA	15.69	32.94^{bc}
100% +Betafin	15.56	33.78^{a}
110% of NRC TSAA	15.60	32.79^{c}
110% + Betafin	15.83	33.58^{a}
120% of NRC TSAA	15.74	32.65^{c}

^{a,b,c}:means within a column without a common letter differ at P<0.05

Key words:
Betafin (poultry), Betafin, betaine, broiler, turkey, breast yield, breast meat, osmolyte

Summary

Betafin, both as an osmolyte and methyl donor, is directly and indirectly involved in metabolism of nutrients that positively affect carcass yield and reduce abdominal fat content. Additionally, as an osmolyte, Betafin has a specific role in water and ion balance metabolism of cells, which ultimately plays a role in metabolic activities such as protein synthesis. Trials conducted at a number of research sites have shown that Betafin supplementation into poultry diets improves carcass yield, breast yield and reduces fat content. In more challenging environments, additional improvements in growth parameters may also be seen.

In conclusion, the average expected improvement in breast yield is approximately 2% (e.g. 28.0% control vs. 28.6% for Betafin). For broilers with a slaughter weight of 2.2 kg and an FCR of 1.8, the additional amount of breast yield gained per tonne of feed will be 2.8 kg in diets supplemented with Betafin (assuming no change in FCR). The payback for using Betafin will be between 3:1 & 7:1 depending upon individual circumstances, prices and dietary reformulation options.

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