White paper

Boost broiler production with Hy·D®

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The attractiveness of poultry meat as a source of animal protein is growing worldwide: poultry currently accounts for 30% of global meat consumption, with this share forecast to grow faster than other types of meat. Combining affordable price with high nutritional value, poultry meat is highly attractive to consumers. The fact that it is not - unlike certain other meats - subject to religious or cultural restrictions, makes it all the more appealing. High performance is therefore a matter of concern not just to broiler producers but also to consumers in all regions of the world.

Advances in genetic science have improved feed conversion rates and accelerated weight gains, resulting in faster overall broiler production. These advances have unfortunately had their downside, such as where bone development has not kept pace with weight gain, resulting in increased locomotion problems in broilers. This in turn translates into reduced performance plus higher incidence of lameness and levels of carcass condemnations in slaughterhouses, putting pressure on the already tight operating margins of poultry producers.

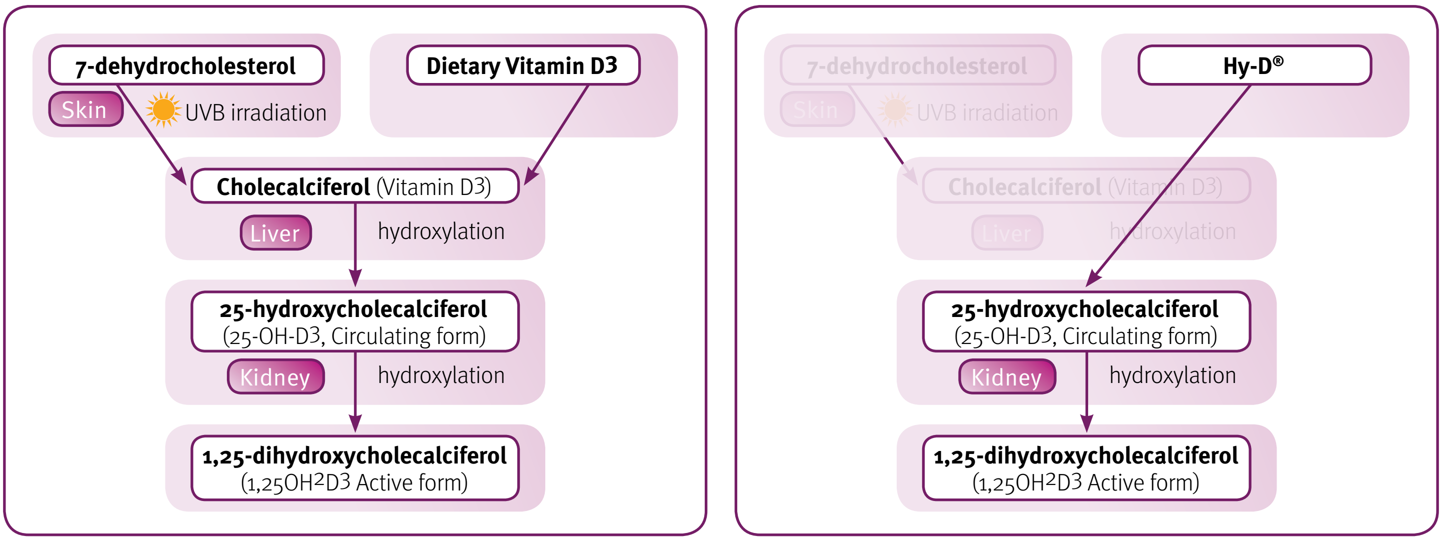
Clearly there is an important role for nutrition-based solutions that will support skeletal development and at the same time deliver birds that are generally stronger and healthier. Vitamin D3 has an important part to play here, due to its role in calcium and phosphorus metabolism.

Vitamin D3 and its metabolites

Vitamin D3 has two metabolites (substances essential to the metabolism of a particular organism or to a particular metabolic process): 25-hydroxycholecalciferol (25-OH-D3) and 1,25-OH2-D3 . The first of these, available from DSM as Hy·D®, is the only one authorized as a feed additive in animal nutrition worldwide and has been shown to improve bone health and provide a range of additional health and performance benefits when added to broiler diets.

It is difficult for commercially bred poultry to produce vitamin D3 in the body – a process which involves the conversion of the natural skin lipid 7-dehyrocholesterol into vitamin D3 via the action of ultra violet light. This essential micronutrient is therefore added to the diet in commercial broiler production. To become metabolically active, vitamin D3 must be metabolized twice following ingestion (Fig 1). The first step is its conversion into the metabolite 25-OH-D3 in the liver. The second step takes place in the kidneys, where 25-OH-D3 is transformed into the metabolite 1,25-OH2-D3.

Fig. 1. The vitamin D3 metabolism in comparison to Hy·D® metabolism



In its active form (1,25-OH2-D3), vitamin D3 primarily supports skeletal development. Added to broiler diets, Hy·D® ensures that sufficient levels of the metabolite 25-OH-D3 are present to synthesize 1,25-OH2-D3. This is particularly important for birds under the age of 7 days, whose natural ability to convert Vitamin D3 into 25OHD3 is limited. The same goes for broilers whose health is compromised by stress or disease. These birds can likewise benefit from the addition of Hy·D® to the diet.

Hy·D® supports bone health

Bone is a dynamic tissue influenced by physiological, nutritional, and physical factors. The rapid growth rates of modern commercial broilers are outpacing the rate of bone growth, however: maximum bone density and breaking strength are not reached until 35 weeks of age in broilers, long after the birds are typically marketed. Bones in fast-growing broiler chickens are therefore characterized by a low mineralization level and high porosity. This makes the birds more prone to injuries and leg disorders such as tibial dyschondroplasia (TD), rickets, femoral head necrosis (FHN), black bone discoloration, gait abnormalities, and lameness.

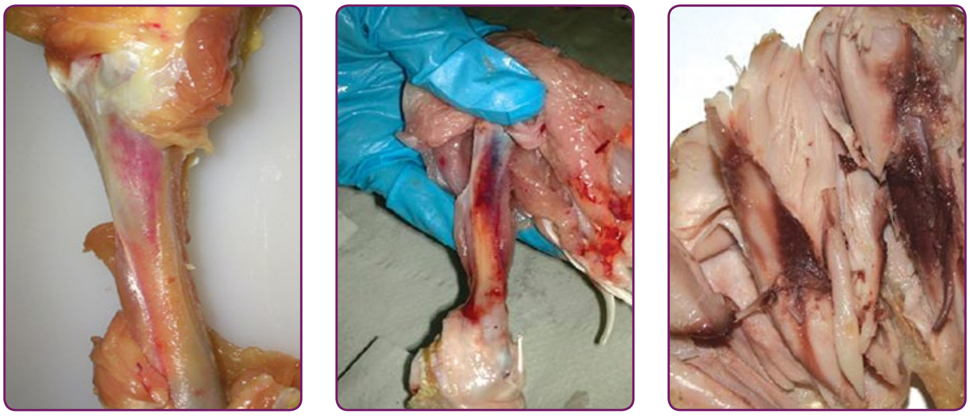
Bone tissue metabolic disorder can be countered by management, environment and nutrition. Crucial here is the correct balance of calcium and phosphorous, which varies depending on the breed, age and health status of the individual bird. The absorption and utilization of calcium and phosphorous are regulated by vitamin D3 and its metabolites.

In several field and experimental broiler trials, supplementation with Hy·D® has been shown to increase bone breaking strength by an average of more than 10%, compared with birds fed only vitamin D3. Replacing vitamin D3 with the same amount of 25-OH-D3 can also reduce the incidence and severity of TD by 55% (Rennie and Whitehead, 1996).

Supplementation with Hy·D® also helps counter lameness. One of the most widespread causes of lameness in broiler flocks is bacterial chondronecrosis with osteomyelitis (BCO), also known as femoral head necrosis. In a recent study in which Hy·D® was made available in the drinking water (Wideman et al., 2015), broilers receiving Hy·D® showed a lower incidence of lameness compared with those receiving plain tap water. The results suggest that the higher levels of 25-OH-D3 in the metabolism of the birds supplemented with Hy·D® may support the immune system, helping to counter manifestations of BCO.

The rapid growth of modern commercial broilers also results in a defect known as "black bone". The faster growth of muscle relative to bone results in porous bones. "Channels" in the compromised bone structure then allow leakage of bone marrow and myoglobin (a protein in heart and skeletal muscles) onto the surface of the bone, which leads to discoloration of the meat. After cooking, the bone appears quite dark; hence the term "black bone" (Fig. 2).

Fig. 2. Black Bone appearance in cooked drumsticks



Bone and meat discoloration caused by the leak out of the bone marrow contents into the surrounding tissues

A consumer survey conducted by Feedinfo in 2012 revealed a clear preference among consumers for chickens that appear healthy and free of the dark pigmentation caused by "black bone".

Several studies conducted in European slaughterhouses in recent years indicate that Hy·D® helps reduce the incidence of "black bone" (Folegatti et al., 2011). More recent investigations (unpublished data) indicate a 13% lower incidence of "black bone" when Hy·D® was fed for the whole production cycle rather than just the starter period. Hy·D® is therefore a key product to help poultry producers improve both the health and the welfare of their birds while at the same time boosting their profitability.

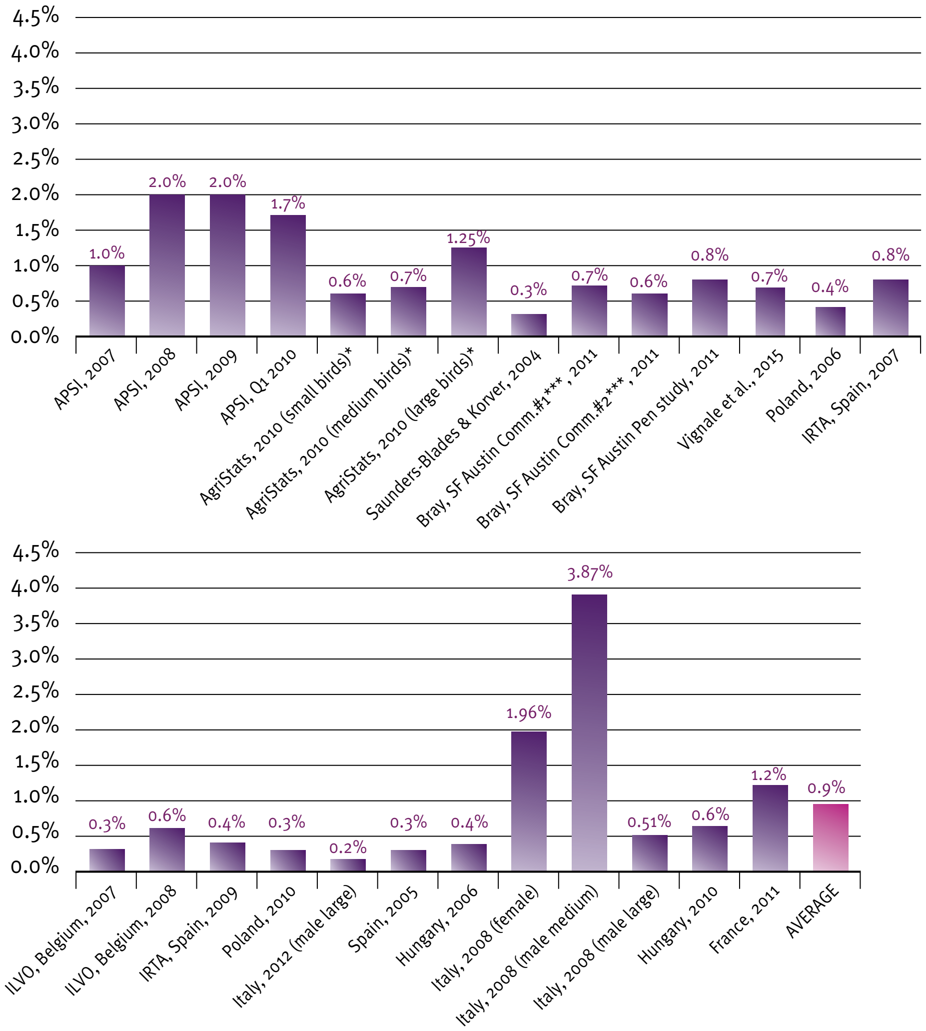
Hy·D® promotes immunity

Hy·D® has a beneficial effect on the immune system of broilers. Newly hatched chicks are more susceptible to infection and disease than mature birds. A study by Saunders-Blades and Korver (2015) showed that supplementation of broiler hens with Hy·D® increased the immune function of chicks. Another study (Chou et al., 2009) showed that broilers supplemented with Hy·D® had a stronger immune system response to salmonella. Liu et al., meanwhile, demonstrated in a 2006 study that supplementation with Hy·D® helps combat intracellular bacteria in broilers, while Morris et al. in 2014 proved that Hy·D® is more effective than vitamin D3 in supporting the immune response in broilers.

Hy·D® boosts performance

In broilers, increased levels of 25-OH-D3 have been positively correlated with increased body weight, improved feed conversion, and higher breast yield (Yarger et al., 1995). Several years of research and field experiences in all regions of the world demonstrate a significant and consistent increase in meat yields from broilers supplemented with Hy·D®.

Graph 1. Hy·D® broiler breast meat trials summary by location and year



Percentage points of breast meat yield increase in birds fed Hy·D® compared to birds fed only vitamin D3

* Vitamin D3 vs. Hy·D® starter & grower; ** Vitamin D3 vs. Hy·D® starter; Hy·D® starter vs. Hy·D® all feeds

Graph 1 presents the results of 26 broiler trials run with different broiler breeds and management systems in various countries of the world. The bars indicate the difference between broilers fed diets supplemented with Hy·D® and broilers fed diets supplemented only with vitamin D3. This impressive data set reveals that the addition of Hy·D® to the broiler diet can enhance breast meat production by almost 1% compared with diets in which vitamin D3 is the sole source of vitamin D3 activity.

Some preliminary studies have attempted to shed light on the action of 25-OH-D3 on myogenesis (the formation of muscular tissue, particularly during embryonic development). During this process, the fibers increase in number, and their number is fixed at birth. After hatching, the muscle cells can only grow in size if additional DNA is available. This DNA is sourced from the satellite cells (muscle fiber support cells necessary for protein synthesis and for increasing fiber size).

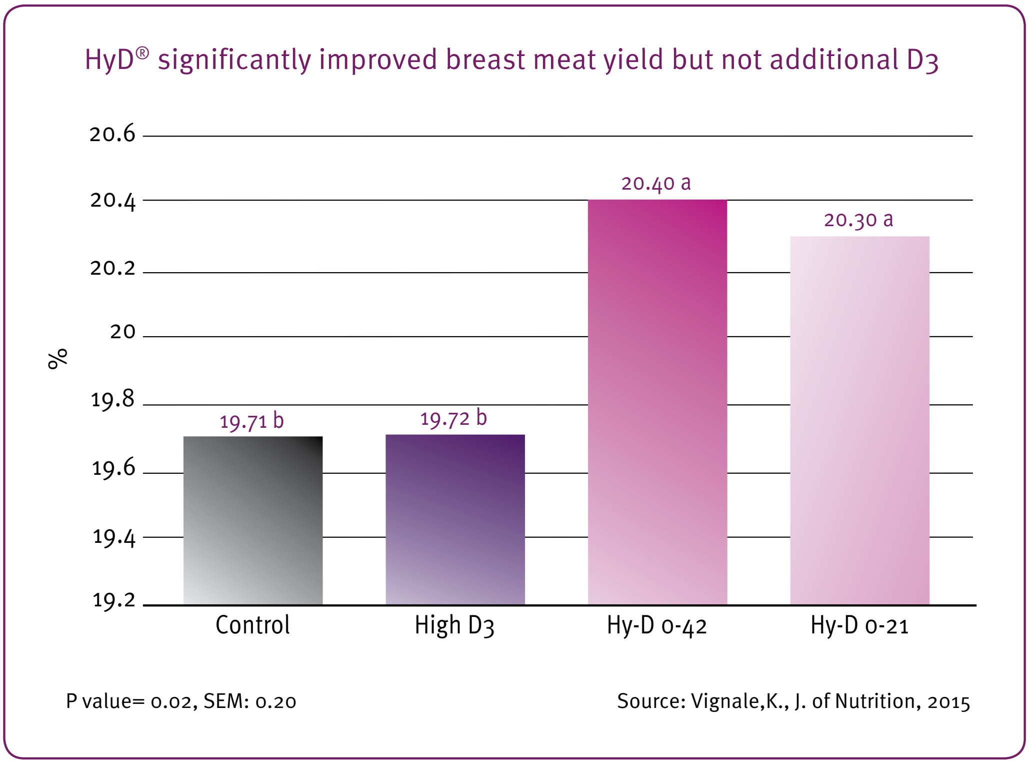
Studies conducted by Berri et al. in 2013, and by Hutton et al. 2014, aimed to evaluate the effect of 25-OH-D3 on skeletal muscle growth and on the activity of the satellite cells in broiler chickens. The results showed a greater proportion of satellite cells in the breast muscles of the birds fed with a combination of vitamin D3 and 25-OH-D3 compared with broilers fed only vitamin D3. Moreover, the number of vitamin D receptors increased in broilers supplemented with Hy·D®, suggesting that this metabolite can enhance the metabolic activity of vitamin D and modulate the expression of specific genes linked to muscle development. These preliminary results may help explain the increase in broiler breast meat yields.

Enhanced meat yield

The research group of Vignale et al. (2015) carried out another study to determine the effect of 25-OH-D3 on protein synthesis (Graph 2). In this trial, four different feed treatments were tested:

1) a control diet with 2.760 IU/kg feed of vitamin D3;
2) a higher (double) amount of vitamin D3, 5.520 IU/kg feed;
3) a combination of vitamin D3, 2.760 IU/kg feed and 25-OH-D3, 2.270 IU/kg feed; and
4) a combination of vitamin D3 and 25-OH-D3 as in treatment (3) for up to 21 days, and then only vitamin D3, 2.270 IU/kg feed up to 42 days (end of trial).

Graph 2. The effect on Hy-D on Breast Meat Yield (%)



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A significantly higher protein synthesis rate was identified in birds fed with Hy·D® for the full cycle (treatment 3). Moreover, in agreement with previous results, the broilers supplemented with Hy·D® for the full period also showed a significantly higher concentration of vitamin D receptors.

As shown in Graph 2, the broilers whose diets were supplemented with Hy·D® also performed better in terms of breast meat production. Surprisingly, birds fed with a higher amount of vitamin D3 showed the same meat production as those broilers fed with half the dose of vitamin D3.

Combined benefits of supplementation with Hy·D®

It can be concluded that Hy·D® has a positive effect on broiler meat yields as the birds' metabolism can make beneficial use of the higher circulating levels of 25-OH-D3 that Hy·D® makes available. Improving the vitamin D status of broilers via dietary supplementation with Hy·D® can stimulate the activity of the satellite cells and thus increase meat yield. As well as boosting performance, supplementing broiler diets with Hy·D® also supports bone health and promotes immunity, enhancing animal welfare while at the same time increasing poultry producers' operating margins.

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