Fibre in layer diets: the importance of choosing the right source

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Dietary fibre has been described as the skeletal remains of plant cells in diets that are not digested by the animal's digestive enzymes. A main distinctive feature amongst different fibre sources is the solubility.

Vegetable roots and fruits like apple, orange and sugar beet deliver mainly soluble fibre (pectin), while all kinds of cereal brans deliver a high percentage of insoluble (cellulosic) fibre. The advantages and disadvantages of soluble and insoluble fibre sources are shown in Table 1.

There is some evidence that insoluble fibres have a positive effect on selected parameters in poultry production. Thus, digestibility of starch is higher and digesta passage rate faster when a moderate level of insoluble fibre is present in the diet.

Due to the faster passage rate there is less accumulation of toxic substances in the intestinal tract. The effect of insoluble fibre on gut function stems from its ability to accumulate in the gizzard, which seems to regulate digesta passage rate and nutrient digestion in the intestine.

Furthermore, there are clear indications that diets high in insoluble fibre are preventive of cannibalism outbreaks in laying hens. In addition to this, recent studies in broiler breeders demonstrated that insoluble fibre has a positive impact on performance in terms of laying percentage as well as on animal welfare.

Soluble fibres do not carry these positive effects. They depress the digestibility of protein, starch and fat due to their negative impact on digesta viscosity.

Soluble fibre	Insoluble fibre
Lowering intestinal passage rate	'Structurising' fibre
Reduces digestion of fat, protein and starch	Improves starch digestibility
Prebiotic effect	Faster intestinal passage rate
Energy source for monogastric animals	Poorly fermentable
Affects viscosity of the digesta	Stimulation of intestinal villi
Mainly fermentable parts	No energy source for young monogastrics
Reduces dry matter of faeces	Increases dry matter content of faeces
Binds nutrients	Prevents cannibalism

Table 1. Effects of soluble and insoluble fibre sources in poultry nutrition.

Fibre in pullets

Lohmann, as well as Hy-Line, emphasise in their feeding guidelines the importance of fibre in the pullet feeding strategy. According to Lohmann, insoluble NSP used in the second half of the rearing period can positively influence the development of the digestive tract, the crop size and the appetite of the pullets. This is the reason why Lohmann implements a minimum recommendation of crude fibre (5-6%) in the developer feed.

Hy-Line point out that diet changes are governed by target body weights in the pullet stage, not bird age. Furthermore, they emphasise that adapting the energy content of the feed can be used to match target weights.

Although high density diets can be used to improve body weight gain, the sustained feeding of diets with higher than recommended energy contents or with a low fibre content can result in inadequate development of the birds' capacity for feed consumption leading to low feed intake and low egg production during early lay. This statement shows that Hy-Line has recognised the importance of fibre in the pullet stage.

According to Lohmann Tierzucht cereals and their byproducts (bran) or oil seed byproducts (meal of sunflowers) can be used as a source of crude fibre. They point out that the recommended crude fibre content is difficult to achieve with a classical corn-soya formulation.

In such cases crude fibre products based on lignocellulose are an option, as they are high in fibre (50-65%), free of mycotoxins and do not consume too much space.

Gizzard size

In the early laying stage the size of the gizzard in pullets is the main obstacle for sufficient feed intake. Especially in heat stress situations a gizzard with a sufficient size is important.

If the gizzard size is inadequate there will be a negative impact on performance as well. The aim should be, therefore, to make sure the gizzard at the end of the pullet stage is as big as possible. It is well established that particle size of feed has impact on the gizzard size. There is not that much information available concerning the fibre source and nature of the gizzard size.

Yokhana et al evaluated the effect of two different fibre products on the gizzard size of pullets. They introduced their results at the European Poultry Conference 2014 in Norway. In this trial pullets were fed from week 8-16 with a standard feed or with two feeds containing different fibre products based on lignocellulose.

One feed contained 1.5% of a fibre product containing significant amounts of bark. The author calls it mixed fibre. The other feed contained 1.5% of a 100% insoluble fibre product (Arbocel, JRS Germany). The results are shown in Table 2.

The insoluble fibre Arbocel caused a significantly higher gizzard weight as well as a higher weight of the small intestine compared to the control animals.

This effect could not be achieved with the bark containing mixed fibre. This confirms the importance of the nature (soluble vs. insoluble) of the fibre as described previously.

Remarkable as well is the improved live weight gain of the animals due to the use of the 100% insoluble fibre. This is of a certain importance as the diet changes are governed by target body weights in pullet rearing and not by age, as mentioned before.

Table 2. Weight gain and organ weights as influenced by different fibre sources in Hy-Line pullets.

	Control	Mixed fibre	Arbocel (insoluble)
Live weight (g)	1419.3[a]	1485.9[a,b]	1580.0[b]
Gizzard (g)	30.2[a]	32.2[a,b]	39.4[b]
Small intestine (g)	23.8[a]	23.4[a,b]	28.3[b]

Fibre in the laying stage

The role of fibre in layers has been reviewed in many papers. There is strong evidence that a minimum level of insoluble fibre is required to prevent behavioural disorders like a retarded neck and cannibalism.

This has been emphasised in the ISA feeding guidelines as well. They state that 'the presence of insoluble fibre appears indispensable, causing an increase in gizzard size, improved starch digestibility and limiting feather pecking'.

Furthermore, it is well established that insoluble fibre will speed up the

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	Feather pecking (%)	Feather conditions*	
		Head & neck	Chest
Control	10.8	0.31	1.56
Arbocel	2.9	0.11	1.21

Table 3. Feather pecking and feather conditions as influenced by the insoluble crude fibre concentrate Arbocel (University of Hohenheim, Germany 2000). (*0 = intact feathering; 5 = no feathers left).

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intestinal transit. This is most probably related to the impact of insoluble fibre on the gizzard size.

This faster intestinal transit will reduce the risk of colonisation of harmful bacteria. For example Branton et al (1997) from the United States Department of Agriculture in Mississippi was able to reduce the incidence of necrotic enteritis in poultry by using insoluble fibre based on lignocellulose.

It is difficult to find recommendations on the level of fibre to be used in the laying stage. It is uncontroversial that the supplemented fibre should be predominantly insoluble.

Robert Pottgüter (2008) from Lohmann summarises in his paper on fibre in layer diets that rations with higher fibre content (i.e. more then 3.5-4.0%) stabilise the gut which also results in drier litter.

Cannibalism

Mortality caused by cannibalism continues to be a major problem in the layer industry. Up to 20% mortality from cannibalism has been noted in some strains, depending on the production system and management strategies. Beside the management, the genetics and the lighting program, dietary factors are also a possible cause of cannibalism.

Low protein diets, low sodium intake as well as a lack of some essential amino acids are seen as a cause of cannibalism. More and more trials also show the importance of an adequate level of insoluble fibre in the formulations to prevent cannibalism.

In a trial at the University of New England in Australia it has been demonstrated that the inclusion of mill run as an insoluble fibre source significantly affected the cannibalism related mortality in layers.

During the laying stage the mortality in the control group fed the wheat based feed (2.9% fibre) was 29%. By using mill runs the mortality was significantly reduced down to 14%.

Similar results have been observed at the University of Stuttgart-Hohenheim, Germany. Here the insoluble crude fibre concentrate Arbocel caused a reduction in feather pecking in layers from 10.8% in the control group to 2.9% in the Arbocel group. In this trial the insoluble crude fibre concentrate resulted in better feather conditions as well (Table 3). It is not yet established why the insoluble fibre causes such positive effects on the cannibalism scenario in layers.

A trial at the University of Hohenheim established that strains with high incidence of feather pecking ingest more feathers than strains with low incidence of feather pecking.

Moreover, the authors discovered that feathers have the same effect in the intestinal tract as insoluble fibre, which is the acceleration of the intestinal transit period. A logical conclusion is that the animals ingest the feathers to overcome a deficiency of insoluble fibre.

Performance

In many farm and university trials a positive impact of insoluble fibre on performance has been observed.

Yuwares Ruangpanit from the Kasetsart University in Thailand (2011) evaluated the effects of the insoluble crude fibre concentrate Arbocel on the hen day egg production in H & N Brown Nick layers from 19-34 weeks of age.

They fed the animals with three different formulations. 3.5% crude fibre from traditional sources, 4.0% crude fibre from traditional sources and 4.0% including 0.5% crude fibre from the insoluble crude fibre concentrate Arbocel. The results are shown in Table 4.

The animals that received 4.0% crude fibre in the formulation including 0.5% crude fibre from the insoluble crude fibre concentrate Arbocel showed almost 2.0% increased hen day egg production (average production in the first 16 weeks) compared to the animals that received the 4.0% crude fibre only from traditional fibre sources.

This demonstrates that the nature of the fibre has a major impact on performance. These results have been confirmed in an on farm trial at the Tynoong North Farm in Australia. The insoluble crude fibre concentrate Arbocel was used during the whole laying stage on 25,000 birds. The performance of these birds in terms of egg production improved by 2.1% compared to the 25,000 control birds.

Summary

The importance of fibre in layer feed formulation has been recognised amongst specialists. The nature of the supplemented fibre is very important. Fibre can be classified into insoluble and soluble fibre.

University and farm trials show that the insoluble fibre is the far better fibre source compared to soluble fibre.

Formulations high in insoluble fibre result in better performance, a bigger gizzard, better intestinal health associated with drier litter, and in a reduced incidence of behavioural disorders like cannibalism.

Due to the energy requirement of laying hens there is often limited space in corn-soya formulations to adjust the fibre content with traditional fibre sources.

Crude fibre concentrates based on lignocellulose are insoluble, highly concentrated (50-65% CF) and without mycotoxin risk. They are a good tool to adapt the fibre content of feed formulations. ■

References are available from the author on request

Table 4. Impact of different fibre sources and different crude fibre level on the performance of layers.

	Control 1	Control 2	Trial
Fibre level and source	**3.5% (traditional)**	**4% (traditional)**	**3.5% traditional & 0.5% from Arbocel**
Hen day egg production (%)	68.15	69.22	71.02
Feed/dozen egg (kg)	1.75	1.74	1.71