

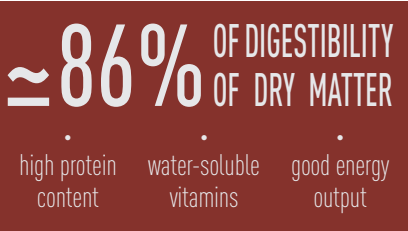
SORGHUM - A SMALL GRAIN WITH REMARKABLE NUTRITIONAL QUALITIES



Today, sorghum cultivation is increasingly becoming an alternative to corn in the situations of limited water reserved. The reasons are numerous. First of all, global warming effects and the need to preserve water resources are evident since last few years. Secondly, 80% of the Eastern Europe planting surfaces are not equipped with irrigation system. Sorghum crop needs low inputs level (pesticide and fertilization) which makes its cost of production competitive.

WHAT ARE THE NUTRITIONAL ADVANTAGES OF SORGHUM IN ANIMAL FEED?

> STARCH AND FAT. The starch and fat contents of sorghum are similar to corn. Moreover, the advantage of sorghum is its **protein content**. Sorghum has a low level of fiber and slightly different from corn amino acids profile: less lysine and sulphurous, but more threonine and tryptophan. It is also a source of **water-soluble vitamins**. Thus, it doesn't contain vitamin A and xanthophyll (The xanthophylls are yellow molecules derived to carotenes). Vitamin A favors the yellow pigmentation of eggs and chicken meat. A consumer preference for the pigmentation depends on the food habits of the population. In Italy for example, consumers prefer white chicken meat and therefore sorghum feed is widely used. For the yellow lover clients, the coloring of chicken can be corrected by exogenous complement, a natural xanthophylls-rich ingredients in the ration.



Composition, g/kg DM	Starch	Proteins	Fat	Wall	Total sugar	Calcium	Phosphorus	Lysine	Threonine	Met + Cys	Tryptophane
SORGHUM	747	109	42	98	13	0.4	3.2	2.5	3.6	3.8	1.2
CORN	747	90	42	105	19	0,5	3,0	2,8	3,5	4,3	0,6



> ENERGETIC VALUE. The sorghum digestible energy is quite high, about 86% of the dry matter (DM), as well as the digestibility of proteins and amino acids.



For growing pork, digestible energy of sorghum is practically equal to corn: 3931 kcal / kg DM for sorghum against 3924 kcal / kg DM for corn (source: INRA); for sows: sorghum - 4002 kcal / kg DM, corn - 4081 kcal / kg DM (source: INRA).

The sorghum fat content is similar to corn but with more favorable fatty acid profile. Fatty acid profile of the pigs ration influences the carcass. Fat contained in sorghum has **less unsaturated fats**. Sorghum has also less inoleic acid and polyunsaturated fatty acid. The advantages of sorghum compare with corn have been confirmed by the researchers. The sorghum grains have good available **phosphorus content**. Compare to corn, the requirement of supplemental inorganic phosphorus is less.

The introduction of sorghum in pork feed has reached 50%. For example, today Spanish ham producers commonly use sorghum grain in their farms. That is the reason why 40% of the total French productions of grain sorghum are exported in Catalonia for pork farm.

Sorghum's flexibility in ration formulation (for example with soybean) allows nutritionist to decrease the costs and maintain good growth performance.



For poultry, the most commonly used cereals in poultry ration are corn, wheat, barley, rice and sorghum. Among them, sorghum is the most energetic cereal. In the United States, sorghum ranks second among the cereals used in farm of broilers, turkeys and laying hens. Since 2009, the energy value of sorghum is relatively stable, and even a little bit higher than of corn. In France, in 2014 the average sorghum energy was 3775 kcal / kg (2013: 3780 kcal / kg), against 3705 kcal / kg for corn (source: INRA). Protein digestibility and amino acid levels are almost identical for sorghum and corn (see table on the right). Some studies have shown that whole and uncrushed sorghum grains may be incorporated in feed without causing loss of the digestibility. It is also possible to introduce up to 55% in rations for turkeys and up to 70% in rations for broilers and laying hens. The unanimous opinion of nutritionists all over the world is that sorghum has very good nutritional value and brings necessary energy for poultry growth (under the condition that sorghum grains have low tannin level).

Composition	BROILERS		LAYING HENS		ROOSTERS	
	Sorghum	Corn	Sorghum	Corn	Sorghum	Corn
Crude Protein (Nx 6.25)	0.82	0.80	0.76	0.78	0.78	0.79
Threonine	0.71	0.67	0.67	0.61	0.67	0.63
Valine	0.84	0.83	0.78	0.77	0.81	0.80
Methionine	0.88	0.91	0.80	0.87	0.84	0.92
Isoleucine	0.87	0.85	0.80	0.81	0.83	0.83
Leucine	0.91	0.91	0.84	0.88	0.88	0.90
Phenylalanine	0.89	0.88	0.82	0.85	0.85	0.87
Histidine	0.75	0.86	0.66	0.79	0.70	0.83
Lysine	0.83	0.79	0.80	0.75	0.81	0.73
Arginine	0.84	0.88	0.81	0.85	0.81	0.86
Average	0.84	0.84	0.77	0.80	0.80	0.82

Table: Coefficients (%) apparent ideal digestibility of crude protein and amino acids of sorghum and corn for broilers, laying hens and roosters (Source Sorghum Checkoff)

ARE THERE ANY PECULIARITIES TO KNOW ON SORGHUM GRAIN?

The crushing is an important point to ensure the digestibility of sorghum, for optimum result crush at 2 mm

Its grains have the same requirements as those of corn. The sorghum particle size is more important for the production of poultry nutriments. Excessive crushing of grain sorghum can cause cross chemical bonds and reduce the amount of available nutrients. Note that a 2 mm of sorghum crushing increase the level of digestibility of main amino acids, in comparison with a 4 mm of sorghum crushing. Note that, a certain % the whole uncrushed sorghum grain might be also used without losses of the digestibility.

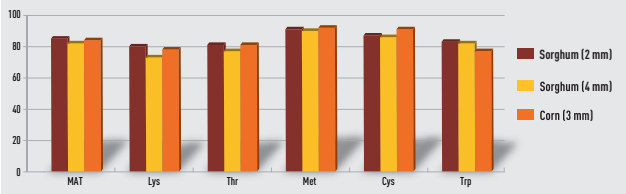


Figure: Effect of crushing on the level of digestibility (%) of amino acid of interest in animal feed.

WHY ANIMAL FEED PRODUCERS MEET DIFFICULTIES WHILE INTRODUCING SORGHUM ON THE MARKET?

Produce more sorghum to avoid a risk of shortage and secure the industry

Definitely nutritionists and animal feed producers agree that sorghum has its place in animal feed with its proven quality. Moreover, financial savings can be made by incorporating sorghum in the rations while keeping the high level of nutritional qualities. From another side, the main concern of the animal feed producers is the lack of sorghum grain, which creates the risk

of ration imbalance. As normally, the ration need is calculated for the whole year and the quantity of available sorghum grain are not sufficient. That is why for the moment sorghum has lower application in the feed compare to corn. Today, we need to produce more sorghum and secure the sector with the optimum balance for the use, as sorghum grain has its proven positive nutritional values.

WHAT IS THE TANNIN CONTENT OF SORGHUM?

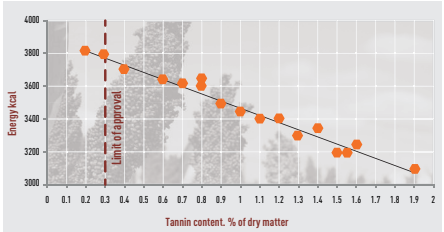


European grain sorghum is certified with very low tannin content

The tannins are concentrated in the husk of the grains. Old varieties of sorghum had very high tannin values: between 1.0 and 3%. Today, those types of sorghums can be essentially found in Southern America, China and sometimes in CIS countries. It helps to limit predator damages in the field, as a high value of tannin makes the grain less appetent.

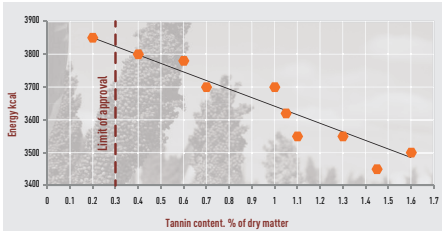
The peculiarity of this anti-nutritional factor of tannin, or polyphenols, is its correlation with protein digestibility. Polyphenols form resistance mechanisms to enzymatic attack in the gastrointestinal tract, which greatly reduce the digestibility of proteins.

For poultry (Grosjean and Metayer, 1993), the presence of tannins linearly affects the energy value of sorghum. For adult cocks for example, 1% tannin reduces 11% the energy value of sorghum.



Graph: Effect of tannin content on energy value in poultry.

For pork (Pérez and Bourdon, 1984), tannins explain at about 80% of the variability of the energy value and digestibility of sorghum grain proteins. 1% tannins reduce by 7% the energetic value of sorghum and by 9% the level of protein value.



Graph: Effect of tannin content on energy value on pork.

That's why since more than 20 years, sorghum breeders are focused on finding the varieties with very low tannin level. It is also interesting to know that the varieties grown in the European Union cannot be listed in the Official Catalogue if their level of tannins is high (should be <0.30% dry matter, ISO 9648). To sum up, by introducing modern sorghum hybrids in the feed ration, a farmer can be sure to have necessary protein values and energy input.



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