The use of soya bean hulls in animal feed

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Soya bean hulls are a by-product of the extraction of oil from soya bean seeds. Hulls are the skin of the soya bean which separates during processing. Once the beans enter the oil mill, they are broken before damaged beans and foreign material are removed. The beans are then cracked and the hulls removed. These hulls are fibrous materials that are valuable in ruminant diets.

Soya bean hulls are small and not very dense. They are often pelleted for ease of handling. Soya bean hulls have a variable chemical composition made up of cellulose (29 to 51%), hemicellulose (10 to 25%), lignin (1 to 4%), pectin (4 to 8%), and proteins (11 to 15%). Due to the composition of soya bean hulls, they are widely used as animal feed and have many advantages by serving as an energy source (*Table 1*).

Swine feed

Pressure to protect the environment by minimising the environmental impact of meat production has been on the increase. Dietary manipulation is one method that has been found to reduce unfavourable emissions from swine facilities.

Soya bean hulls are an inexpensive by-product of soya bean processing and are high in fibre, which have been shown to have a positive impact on manure nitrogen retention, odour production, aerial pit emissions, and volatile fatty acid production. The addition of 10% soya bean hulls with supplemental fat to a commercial type of diet, can have a positive impact on the environment without diminishing swine performance.

Research has shown that growing and finishing swine on diets containing 6 to 8% soya bean hulls resulted in

better daily gain. However, swine fed a diet containing 24% soya bean hulls showed decreased performance.

Growing swine on a diet containing soya bean hulls had an average bodyweight gain of 16,2 to 17,3kg after a three-week period, and a 39,7 to 40,9kg weight gain after six weeks, with an overall average bodyweight gain of 35kg. Finishing swine on a diet containing soya bean hulls produced an average bodyweight gain of 23 to 23,9kg. Back fat thickness measured 2,2 to 2,3cm and loin eye muscle 24,7 to 26,3cm, which is 6% lower than that of swine fed a diet containing wheat bran.

Research has indicated that low levels of soya bean hulls may be added to nursery diets without negatively affecting swine performance. This may reduce diet costs since soya bean hulls are cheaper than maize. Research also suggests that nursery swine weighing between 11,33 and 22,6kg can be fed diets containing 4% soya bean hulls and 15 to 22% dried distiller grains, with no negative effect on average daily gain.

Poultry diets

Soya bean hulls have shown to be poorly digested by non-ruminant animals. They do, however, have the potential to serve as an alternative feed ingredient for swine and poultry.

An inclusion of up to 20% soya bean hulls in laying hen diets lowers feed cost. The increased feed intake of birds on diets containing soya bean hulls does not have a negative impact on

performance due to soya bean hulls' high fibre content. It is an affordable and suitable energy source for laying birds.

The addition of exogenous enzymes with the soya bean hulls increases the availability of starches, proteins, and minerals, which are either enclosed in fibre-rich cell walls and are therefore not accessible to the animals' own digestive enzymes or are in a chemical form which the animal is unable to digest. The addition of the enzymes helps break down specific chemical bonds in raw materials, releasing more nutrients and improving animal performance.

Lactating dairy cows

Soya bean hulls can replace maize to supply 30% of DM in high grain diets without affecting the fermentation and digestion of nutrients negatively. Feed costs account for 35 to 50% of the total cost to produce milk. By including soya bean hulls, dairy producers can reduce feeding costs – especially when milk prices are low – to maximise the efficiency of production.

Soya bean hulls can be successfully used as a good fibre source in rations for dairy cattle when forages are either of poor quality or in short supply. The nutritional value of soya bean hulls is affected by the rate at which they are digested in the rumen and by the rate at which they pass from the rumen to the lower gastrointestinal tract. Studies have shown that ruminal micro-organisms are capable of extensively fermenting soya bean hulls at high rates.

Feedlot rations

Soya bean hulls should be considered in feedlot rations when readily accessible and priced competitively with other feedstuffs. They serve as an alternative to high-starch grains

Table 1: Nutritional analysis of soya bean hulls vs maize and wheat by-products. (Source: *Feedipedia*, 2021)

Main analysis	Soya bean hulls		Wheat bran		Maize bran	
	Unit	Average	Unit	Average	Unit	Average
Dry matter (DM)	% as feed	89,1	% as feed	87	% as feed	88,7
Crude protein	% DM	13,1	%DM	17,3	% DM	11,9
Crude fibre	% DM	38,9	% DM	10,4	% DM	12,3
NDF	% DM	64,4	% DM	45,2	% DM	44,2
ADF	% DM	46,2	% DM	13,4	% DM	14,5
Lignin	% DM	2,3	% DM	3,8	% DM	2,2
Ether extract	% DM	2,2	% DM	3,9	% DM	4,6
Ash	% DM	5,2	% DM	5,6	% DM	5,8
Starch (polarimetry)	% DM	5,2	% DM	23,1	% DM	35
Total sugars	% DM	1,6	% DM	7,2	% DM	2,8
Gross energy	MJ/kg DM	18,2	MJ/kg DM	18,9	MJ/kg DM	18,5
Minerals	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Calcium	g/kg DM	5,5	g/kg DM	1,4	g/kg DM	4,7
Phosphorus	g/kg DM	1,6	g/kg DM	11,1	g/kg DM	3,4
Potassium	g/kg DM	13,8	g/kg DM	13,7	g/kg DM	7,3
Sodium	g/kg DM	0,1	g/kg DM	0,1	g/kg DM	0,8
Magnesium	g/kg DM	2,6	g/kg DM	4,5	g/kg DM	2,2
Manganese	g/kg DM	24	g/kg DM	114	g/kg DM	15
Zinc	g/kg DM	48	g/kg DM	89	g/kg DM	97
Copper	g/kg DM	8	g/kg DM	13	g/kg DM	7
Iron	g/kg DM	669	g/kg DM	155	g/kg DM	68
Amino acids	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Alanine	% protein	4,2	% protein	4,6	% protein	5,5
Arginine	% protein	4,7	% protein	6,8	% protein	6,4
Aspartic acid	% protein	9,2	% protein	7	% protein	6,5
Cystine	% protein	1,8	% protein	2,1	% protein	1,4
Glutamic acid	% protein	10,1	% protein	19	% protein	11,6
Glycine	% protein	7,9	% protein	5,1	% protein	4,9
Histidine	% protein	2,5	% protein	2,7	% protein	2,9
Isoleucine	% protein	3,4	% protein	3,2	% protein	3,3
Leucine	% protein	6	% protein	6	% protein	7,1
Lysine	% protein	6,3	% protein	4	% protein	4
Methionine	% protein	1,1	% protein	1,5	% protein	1,7
Phenylalanine	% protein	3,6	% protein	3,9	% protein	4
Proline	% protein	4,7	% protein	6,3	% protein	4,4
Serine	% protein	5	% protein	4,3	% protein	3,8
Threonine	% protein	3,5	% protein	3,2	% protein	3,4

Table 1 (continued): Nutritional analysis of soya bean hulls vs maize and wheat by-products. (Source: *Feedipedia*, 2021)

Amino acids (continued)	Unit	Average	Unit	Average	Unit	Average
Tryptophan	% protein	0,8	% protein	1,4	% protein	0,8
Tyrosine	% protein	3,8	% protein	2,7	% protein	2,7
Valine	% protein	4,3	% protein	4,6	% protein	5,2
Secondary metabolites	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Tannins (e.g., tannic acid)	g/kg DM	2,6	g/kg DM	1,3	g/kg DM	–
Ruminant nutritive values	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
OM digestibility, ruminants	%	81,8	%	73,4	%	78,4
Energy digestibility, ruminants	%	79,6	%	71,4	%	78,8
DE ruminants	MJ/kg DM	14,5	MJ/kg DM	13,5	MJ/kg DM	16,3
ME ruminants	MJ/kg DM	11,5	MJ/kg DM	11	MJ/kg DM	13,1
ME ruminants, digestibility	MJ/kg DM	6,2	MJ/kg DM	13,5	MJ/kg DM	–
Nitrogen digestibility	MJ/kg DM	6,2	MJ/kg DM	13,5	MJ/kg DM	–
a (N)	%	30,3	%	28,8	%	13,5
b (N)	%	66,5	%	66,2	%	82,9
c (N)	h-1	0,043	h-1	0,200	h-1	0,075
Nitrogen degradability (effective, k=4%)	%	65	%	84	%	68
Nitrogen degradability (effective, k=6%)	%	58	%	80	%	60
Swine nutritive values	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
Energy digestibility, growing swine	%	50,5	%	57,1	%	73,5
DE growing swine	MJ/kg DM	9,2	MJ/kg DM	10,8	MJ/kg DM	15,4
MEn growing swine	MJ/kg DM	8,6	MJ/kg DM	10,2	MJ/kg DM	14,4
NE growing swine	MJ/kg DM	4,6	MJ/kg DM	7,2	MJ/kg DM	9,2
Nitrogen digestibility, growing swine	%	40,4	%	64,9	%	71
Poultry nutritive values	**Unit**	**Average**	**Unit**	**Average**	**Unit**	**Average**
AMen cockerel	MJ/kg DM	–	MJ/kg DM	7,8	MJ/kg DM	–
AMen broiler	MJ/kg DM	–	MJ/kg DM	7,4	MJ/kg DM	9,8

Table 2: Crush volumes and theoretical hull availability vs maize and wheat by-products.

Season	Soya beans crushed (tons)	Theoretical hull availability (%)	Wheat bran (tons)	Maize bran (tons)
2014/15	561 590	22 464	621 804	968 642
2015/16	861 631	34 465	628 416	939 692
2016/17	988 024	39 521	632 132	961 844
2017/18	852 308	34 092	640 946	998 695
2018/19	891 425	35 657	650 282	1 032 144
2019/20	1 054 566	42 183	682 920	1 077 514
2020/21	1 269 610	50 784	–	1 137 024

since they contain high levels of digestible fibre and can also be used as an energy source with similar value to other grains.

Research suggests that soya bean hulls do not affect calf weight, dry matter (DM) intake, or feed efficiency. Average daily gain on a ration containing soya hulls increased by 15 to 45%, suggesting that using soya hulls as a concentrate component in receiving diets is most effective at a level of 15 to 30%. Soya hulls provide the rumen with more digestible fibre and degradable protein when compared with maize.

Availability in South Africa

Soya bean hulls are a by-product from the solvent extraction process to produce soya bean meal. The quantity available is directly correlated with crush volumes in South Africa.

Table 2 illustrates that despite the extremely healthy growth in soya bean crush volumes, the availability of 50 784 tons is very little compared to the 1 819 944 tons of milling by-products currently available in South Africa.

Soya bean hulls will, however, always be in demand, especially if the price is reasonable and in ruminant rations where they receive preference. South Africa can easily produce animal feed cost-effectively without soya bean hulls. Nevertheless, soya bean hulls have become a sought-after ingredient and contribute to the higher fibre raw materials available in South Africa, albeit in small quantities.

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