Peanut hulls

Click on the "Nutritional aspects" tab for recommendations for ruminants, pigs, poultry, rabbits, horses, fish and crustaceans

 

Common names

Peanut hulls, peanut shells, peanut husks, groundnut hulls, groundnut shells, groundnut husks

Species

Arachis hypogaea L. [Fabaceae]

Feed categories

- Legume seeds and by-products
- Oil plants and by-products
- Plant products and by-products

Related feed(s)

- Peanut seeds
- Peanut meal
- Peanut forage
- Peanut skins

Description

The fruit (pod, nut) of the peanut (*Arachis hypogaea* L.) consists of an external hull (or shell) (21-29%) surrounding the nut (79-71%) (van Doosselaere, 2013; Davis et al., 2016). Peanut hulls, not to be confounded with peanut skins (which are the thin paper-like seed coats enclosing the kernel), are a by-product of peanut processing. The shelling of peanuts is often the second operation (after cleaning) of peanut processing, as both the production of peanut oil and the production of peanut snacks, peanut butter and other peanut-based foods require kernels without hulls (except the production of in-shell peanuts). Peanut hulls usually consist of fragmented hulls with variable amounts of whole or broken kernels (Hill, 2002).

Peanut hulls are a bulky waste generated in large amounts. In peanut-producing countries, they are often burned, dumped, or left to deteriorate naturally (Singh et al., 1999). In the recent past environmental concerns have led to an interest in using peanut shells for a variety of purposes: fuel, mulch, carrier for chemicals and fertilizers, bedding for livestock and poultry, pet litter, soil conditioners, etc. (Hill, 2002). Peanut hulls are also fed to livestock, particularly ruminants and rabbits, although their high fibre content does not make them suitable for most monogastric species.

Distribution

Peanut is a major crop widely distributed throughout tropical, subtropical, and warm temperate areas in Asia, Africa, Oceania, North and South America, and Europe (Freeman et al., 1999). Crushing peanuts for oil and meal remains a major use of the crop, but direct utilisation for food has been steadily increasing since the 1970s. About 45% of the world peanut production was used for food in 2010-2013, with 60% or above going to the food market in North America, Southern Africa, West Africa and South-Eastern Asia. However, only 41% of the production is used as food in Eastern Asia and 13% in South-Western Asia (Fletcher et al., 2016). The worldwide production of peanuts (with shells) was 40 million tons in 2015. 40% was produced in China, 19% in the other Asian countries, 18% in Africa and 11% in the Americas (USDA, 2016). Assuming that peanut shells constitute 20% of the weight, it can be estimated that 8 million tons of peanut shells are produced each year.

Environmental impact

Peanut shells are a major industrial waste in peanut-producing countries. Their utilisation by livestock helps alleviate their environmental burden.

Datasheet citation

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Nutritional attributes

Peanut hulls are mostly comprised of fibre, with a crude fibre content that often exceeds 60% of DM, and a lignin content in the 6-45% DM range. Due to the presence of kernel fragments, peanut hulls contain small, but significant, variable amounts of protein (average 7% of DM) and oil (2% of DM).

Potential constraints

Aflatoxins

Peanuts are particularly vulnerable to contamination by fungi *Aspergillus flavus* and *Aspergillus parasiticus.* These fungi produce aflatoxins that are known to cause cancers in humans, increase incidents of hepatitis viruses B and C, lower the immune response, impair growth in children and cause childhood cirrhosis. In poultry and livestock, aflatoxins can cause loss of appetite, loss of weight, reduced egg production, and contamination of milk (ICRISAT, 2016). Aflatoxin contamination may occur in the field, after peanuts are lifted but before harvest, during transport, and during storage (Payne, 2016). As of 2016, the maximum authorised content in the EU for aflatoxin B1 in feed materials is 0.02 mg/kg (20 ppb or µg/kg) (European Commission, 2003). The risk of aflatoxin contamination in peanut products is discussed more extensively in the Peanut meal datasheet. Peanut hulls, like other parts of the peanut fruit, can be contaminated with aflatoxins.

Handling

Peanut hulls, ground or unground, flow poorly and are difficult to handle with conventional equipment (Lindemann et al., 1986).

Ruminants

Due to their high fibre content, peanut hulls can be used as a roughage source in ruminant diets, particularly for beef cattle, sheep and goats.

Digestibility and energy values

With their high fibre content, peanut hulls have a high potential as a low-quality roughage source, especially as an alternative to hay in hot and dry climates (Palmer, 2010; Aregheore, 2001). Their low bulk density makes them difficult to transport and many processors grind or pellet them. However, decreasing the particle length of the peanut hull decreases its effectiveness as a fibre source (Utley et al., 1973).

Peanut hulls have a very low digestibility. *In vitro* DM digestibility ranges from 16 to 25% (Barton et al., 1974), and *in vivo* OM digestibility is about 20% (Alibes et al., 1990). Many studies have tried to improve the digestibility of peanut hulls by chemical treatment with sodium chlorite, ammonia, sodium hydroxide, chlorine gas, calcium hypochlorite, and other more exotic chemicals. For instance, alkali treatment (6 kg NaOH per 100 kg of hulls) of peanut hulls was shown to increase the level of potentially digestible dry matter, while alkali treatment of fine-ground hulls reduced it in diets for for steers (Maglad et al., 1986). Treatment with urea or fungus (*Trichoderma viride*) increased *in vitro* digestibility in sheep (Abo-Donia et al., 2014). However, these treatments may be costly and/or difficult to use due to the dangerous nature of the chemicals and lack of care in their use. Furthermore, many studies stress the resistance of peanut hulls to chemical treatments used to improve digestibility (Hill, 2002).

Dairy cows

Peanut hulls are probably usable as a source of roughage for dairy cows, provided that no aflatoxin contamination is detected. However, only one study concerning peanut hulls was found. Different fibre sources were compared for lactating dairy cows, including a 50:50 mixture of peanut hulls and ground cardboard included at 20% of the diet. This mixture gave a similar response as the other fibre sources tested (cottonseed hulls and ground cardboard) (Van Horn et al., 1984).

Beef cattle

Average daily gain and carcass characteristics were similar for steers fed diets containing from 5 to 30% peanut hulls, and slightly higher than for steers fed diets without peanut hulls (substituted by ground maize grain). However, concentrations of between 10 and 20% peanut hulls appeared to be better for promoting body weight gains compared to 0 or 30% peanut hull diets. Intake increased proportionately to the level of hulls in the diet (Utley et al., 1972). Other studies have shown that, if properly processed, and fed at an appropriate level in the diet, peanut hulls can be effectively utilized by all classes of beef cattle (Hill, 2002).

Sheep

Compared to other crop residues (maize cobs or cassava peel), the inclusion of 30% of peanut hulls in maize based diets supplemented with urea enabled acceptable body weight gains, although slightly lower than with the other residues (31 *vs.* 41 g/day; Aregheore, 1996). In growing lambs, diets including 25% of urea-treated peanut hulls (4 g/kg DM urea added to the ensiled hulls 6 weeks before use) were supplemented with peanut cake, cotton seed cake or fish by-products. They were utilized more efficiently by sheep (higher feed intake, daily weight gain and final body weight) than the untreated basal diets (Abdel Hameed et al., 2013). When compared with no treatment or a urea-based treatment, a diet based on peanut hulls treated with fungus offered to Ossimi rams led to increased feed intake, nutrient digestibility, and nitrogen balance (intake and retention) (Abo-Donia et al., 2014).

Goats

Compared with other crop residues (maize cobs, cassava peel, cocoa pod husks), the inclusion of 30-35% of peanut hulls in the diet of goats led to similar digestibility, voluntary feed intake and growth rate (Aregheore, 1995; Aregheore, 1996). In Zambia, during the hot dry season, growth rate obtained with goats fed up to 46% of peanut hulls, in a maize based diet supplemented with urea, was comparable to that from Gwembe valley goats and Small East African goats during favourable climatic conditions (Aregheore, 2001). The voluntary intake and growth rate showed that, if the residues are properly processed, they can meet the nutritional requirements of livestock during adverse weather conditions.

Pigs

Peanut hulls are rich in fibre and of limited value for pigs, except as a roughage source for those that require it.

Growing pigs

In an evaluation of 4 fibre sources for growing and finishing pigs, peanut hulls supported greater daily gains than maize cobs, alfalfa meal and fescue grass in diets containing 4 or 8% crude fibre. However, peanut hulls comprised a very small part of the diet due to its large fibre content (Baird et al., 1970). Growing and finishing pigs fed diets containing between 7.5 and 22.5% peanut hulls increased intake and maintained performance. However, the low energy and nutrient digestibility, the changes in mineral retention, and the linear reductions in body weight gain with increasing levels of peanut hulls in the diet suggest that peanut hulls have limited value in growing and finishing diets (Lindemann et al., 1986).

Sows

No deleterious effects were observed on reproductive and lactating performance when gestating sows were allowed *ad libitum* access to a diet containing 56% ground peanut hulls (Leibbrandt, 1977).

Poultry

Peanut hulls do not have any nutritive value for poultry. They can be used as bedding material, as an alternative to wood shavings (Lien et al., 1998). However caution should be taken if hulls are contaminated with aflatoxins.

Rabbits

Peanut hulls are used successfully as a source of fibre in rabbit diets. They have been included in experimental diets for growing rabbits or for breeding does (Abd El Gadir, 1999; Tao et al., 2006; Chao et al., 2008; Elamin et al., 2011a; Elamin et al., 2011b). The incorporation level varies, generally between 8 and 25% of the diet (Elamin et al., 2011a; Adam, 2013; Yang GuiQin et al., 2011), but it was included at up to 60% of the control diet in one experiment (Yousif, 1999). Due to the high fibre content and despite the very high level of lignin, the digestible energy content was low, between 4.7 and 6.5 MJ/kg DM, and nitrogen digestibility was low to moderate, between 29 and 58% (Yang GuiQin et al., 2011; Wang YuanYuan et al., 2013; Lebas, 2016). Several studies mention that peanut hulls are well utilised in rabbit diets, but some major health problems have also been described. For example a study in China has reported an epidemic of "weak and limp disease" in rabbits, which was clearly an occurrence of aflatoxicosis caused by badly stored peanut shells and vines. However, the mycotoxin level was not assessed (Gu ZiLin et al., 2005). Aflatoxins were also detected (39 µg/kg) in commercial peanut hulls (Lien et al., 1998), while other samples were found to be free of aflatoxins (Hegazy et al., 1991).

Peanut hulls may be considered as a potential source of fibre for rabbit feeding, but careful consideration should always be given to storage and preservation conditions, and to the risks of aflatoxin contamination.

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Tables of chemical composition and nutritional value

- Peanut hulls

Avg: average or predicted value; SD: standard deviation; Min: minimum value; Max: maximum value; Nb: number of values (samples) used

Peanut hulls

Main analysis	Unit	Avg	SD	Min	Max	Nb
Dry matter	% as fed	91.6	2.6	87.2	96.1	26
Crude protein	% DM	7.0	1.6	4.0	10.5	33
Crude fibre	% DM	65.9	9.6	43.9	80.5	27
NDF	% DM	66.4	17.9	27.6	87.0	13
ADF	% DM	56.4	18.7	13.1	76.2	12
Lignin	% DM	22.4	11.8	5.8	45.2	15
Ether extract	% DM	2.0	1.8	0.2	7.3	15
Ash	% DM	5.2	2.4	2.0	11.6	33
Gross energy	MJ/kg DM	19.8	1.9	17.8	22.0	4 *

Minerals	Unit	Avg	SD	Min	Max	Nb
Calcium	g/kg DM	2.4	1.6	1.3	7.0	19
Phosphorus	g/kg DM	0.7	0.5	0.3	2.2	19
Potassium	g/kg DM	6.9	2.3	1.7	9.1	8
Sodium	g/kg DM	0.1	0.1	0.0	0.2	12
Magnesium	g/kg DM	1.2	0.3	0.9	1.8	9
Manganese	mg/kg DM	38	11	29	50	3
Zinc	mg/kg DM	64	70	23	145	3
Copper	mg/kg DM	15	8	9	27	4
Iron	mg/kg DM	210	92	109	295	4

Amino acids	Unit	Avg	SD	Min	Max	Nb
Alanine	% protein	4.4				1
Arginine	% protein	3.0				1
Aspartic acid	% protein	13.6				1
Glutamic acid	% protein	10.8				1
Glycine	% protein	4.7				1
Histidine	% protein	2.4				1
Isoleucine	% protein	3.7				1
Leucine	% protein	6.3				1
Lysine	% protein	4.6				1
Phenylalanine	% protein	3.9				1
Proline	% protein	8.9				1
Serine	% protein	4.4				1
Threonine	% protein	3.3				1
Tyrosine	% protein	1.3				1
Valine	% protein	4.9				1

Ruminant nutritive values	Unit	Avg	SD	Min	Max	Nb
OM digestibility, ruminants	%	20.1		20.0	20.1	2
OM digestibility, ruminants (gas production)	%	8				1
Energy digestibility, ruminants	%	17.3				*
DE ruminants	MJ/kg DM	3.4				*
ME ruminants	MJ/kg DM	2.7				*
ME ruminants (gas production)	MJ/kg DM	4.5				1

Nitrogen digestibility, ruminants	%	18.7		0.0	37.4	2

Pig nutritive values	Unit	Avg	SD	Min	Max	Nb
Energy digestibility, growing pig	%	32.5				1
DE growing pig	MJ/kg DM	6.4				*
Nitrogen digestibility, growing pig	%	29.6				1

The asterisk * indicates that the average value was obtained by an equation.

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