Int.J.Curr.Res.Aca.Rev.2022; 10(04): 119-129

International Journal of Current Research and Academic Review

ISSN: 2347-3215 (Online) Volume 10 Number 04 (April-2022)

Journal homepage: http://www.ijcrar.com

doi: https://doi.org/10.20546/ijcrar.2022.1004.010

Anti-Nutritional Factors in Livestock Feed, Effect on Animal Performance and Methods of Mitigation. A Review

Chala Edea*

Debre Zeit Agricultural Research Center Po.box 32. Bishoftu, Ethiopia

**Corresponding author*

Abstract

Anti-nutritional factors are compounds which reduce the nutrient utilization and/or feed intake of plants or plant products used as animal feeds. Numerous Anti-nutritional factors (ANFs) in feeds can cause toxicity in livestock. The major anti- nutrients found in livestock feed sources are tannins, saponins, cyanogenic glycosides, phytic acid, oxalates, protease inhibitors, gossypol and mycotoxins. Tannins are heat stable and they decreased protein digestibility in animals, probably by either making protein partially unavailable or inhibiting digestive enzymes and increasing fecal nitrogen and responsible for decreased feed intake, growth rate, feed efficiency and protein digestibility. Saponins can affect animal performance and metabolism through erythrocyte haemolysis, reduction of blood and liver cholesterol, depression of growth rate, bloat (ruminants), inhibition of smooth muscle activity, enzyme inhibition and reduction in nutrient absorption. Oxalic acid on the other hand binds calcium and forms calcium oxalate which adversely affects the absorption and utilization of calcium in the animal body. Phytic acid forms protein and mineral-phytic acid complexes and reduces protein and mineral bioavailability, inhibits the action of gastrointestinal tyrosinase, trypsin, pepsin, lipase and amylase. Gossypol pigment in cottonseed occurs in free and bound forms. Free gossypol is the toxic entity and causes organ damage, cardiac failure and death. Alkaloids are one of the largest groups of chemical compounds synthesised by plants and generally found as salts of plant acids such as oxalic, malic, tartaric or citric acid. Mycotoxins are toxic secondary metabolites produced by fungi toxic to livestock and plants and heir ingestion, inhalation or dermal absorption may cause different diseases and even death. Protease inhibitors are the most commonly encountered class of ant nutritional factors of plant origin which have the ability to inhibit the activity of proteolytic enzymes within the gastrointestinal tract of animals. A number of methods can be employed to reduce the toxic effects of ant nutrients in animal feed.

Article Info

Received: 02 March 2022
Accepted: 30 March 2022
Available Online: 20 April 2022

Keywords

antinutritional factors, animal performance, methods of mitigation.

Introduction

Anti-nutritional factors are substances which either by themselves or through their metabolic products, interfere with feed utilization and affect the health and production of animal or which act to reduce nutrient intake, digestion, absorption and utilization and may produce other adverse effects (Akande *et al.*, 2010). Some of chemicals are known as ‘‘secondary metabolites’’ and they have been shown to be highly biologically active and most of these secondary metabolites elicit very harmful biological responses, while some are widely applied in nutrition and as pharmacologically- active agents (Soetan, 2008).

Anti-nutritional factors are a chemical compounds synthesized in natural food and / or feedstuffs by the normal metabolism of species and by different mechanisms (for example inactivation of some nutrients, diminution of the digestive process or metabolic utilization of food/feed) which exerts effect contrary to optimum nutrition (Soetan and Oyewol, 2009). Such chemical compounds, are frequently, but not exclusively associated with foods and feeding stuffs of plant origin.

Antinutrients are chemicals which have been evolved by plants for their own defense, among other biological functions and reduce the maximum utilization of nutrients especially proteins, vitamins, and minerals, thus preventing optimal exploitation of the nutrients present in a feed and decreasing the nutritive value. Some of these plant chemicals have been shown to be deleterious to health or evidently advantageous animal health if consumed at appropriate amounts (Ugwu and Oranye, 2006). This being the case, the objectives of this review are to describe different anti-nutritional factors toxicant in livestock feed, effect on animal Performance and Methods of Mitigation.

Common antinutritional substances and inherent toxicants of feeds and forage

Anti-nutritional factors (ANF) are compounds which reduce the nutrient utilization and/or food intake of plants or plant products used as human foods or animal feeds and they play a vital role in determining the use of plants for humans and animals (Soetan and Oyewole, 2009). The toxicity due to the consumption of various forages is very common among the farm animals. The anti-nutritional factors present in the forages are mainly responsible for this (Smitha Patel *et al.*, 2013. The major ones includes: toxic amino acids, saponins, cyanogenic glycosides, tannins, phytic acid, gossypol, oxalates, goitrogens, lectins (phytohaemagglutinins), protease inhibitors, chlorogenic acid and amylase inhibitors (Akande *et al.*, 2010).

Many plant components have the potential to precipitate adverse effects on the productivity of farm livestock (D'Mello, 2000). These compounds are present in the foliage and/or seeds of virtually every plant that is used in practical feeding. Plant toxins may be divided into a heat-labile group, comprising lectins, protease inhibitors and cyanogens, which are sensitive to standard processing temperatures and a heat-stable group which include antigenic proteins, condensed tannins, quinolizidine alkaloids, glucosinolates, gossypol, saponins, the non-protein amino acids like S-methyl cysteine sulphoxide and mimosine, and phyto-estrogens.

The anti-nutritional factors may be classified on the basis of their effects on the nutritional value of feedstuffs, and on the biological response to them in the animal. Huisman and Tolman (2001) divided the antinutritional factors into groups:

Factors with a depressive effect on protein digestion and on the utilization of protein, such as protease inhibitors, tannins and saponins;

Factors that affect mineral utilization, which include phytates;

Factors that stimulate the immune system and may cause a damaging hypersensitivity reaction, such as antigenic proteins;

Tannins

Tannin is an astringent, bitter plant polyphenolic compound that either binds or precipitates proteins and various other organic compounds including amino acids and alkaloids. Tannins are the most widely occurring antinutritional factors found in plants. Tannins have a property of binding to protein to form reversible and irreversible complexes due to the existence of a number of phenolic hydroxyl groups. Tannins are water soluble phenolic compounds with molecular weight greater than 500 and hydrolysable tannins and condensed tannins are two different groups of these compounds (Smitha patel *et al.*, 2013). The two types differ in their nutritional and toxic effects. The condensed tannins have more profound digestibility-reducing effect than hydrolysable tannins, whereas, the latter may cause varied toxic manifestations due to hydrolysis in rumen (Akande *et al.*, 2010).

Tannins are heat stable and they decreased protein digestibility in animals probably by either making protein partially unavailable or inhibiting digestive enzymes and increasing fecal nitrogen. Tannins are known to be responsible for decreased feed intake, growth rate, feed efficiency and protein digestibility in experimental animals. If tannin concentration in the diet becomes too high, microbial enzyme activities including cellulose and intestinal digestion may be depressed. Tannins also form insoluble complexes with proteins and the tannin protein complexes may be responsible for the anti-nutritional effects of tannin containing foods (Habtamu and Nigussie, 2014).

Saponins

Saponins are secondary compounds that are generally known as non-volatile, surface active which are widely distributed in nature, occurring primarily in the plant kingdom. They are structurally diverse molecules and consist of non polar aglycones coupled with one or more monosaccharide moieties. This combination of polar and non-polar structural elements in their molecules explains their soap-like behavior in aqueous solutions. The structural complexity of saponins results in a number of physical, chemical, and biological properties, which include sweetness and bitterness, foaming and emulsifying, pharmacological and medicinal, haemolytic properties, as well as antimicrobial, insecticidal activities (Habtamu and Ngusse, 2014).

Saponins reduce the uptake of certain nutrients including glucose and cholesterol at the gut through intra-lumenal physicochemical interaction. Hence, it has been reported to have hypo cholesterolemic effects. In chickens saponnin have been reported to reduce growth, feed efficiency and interfere the absorption of dietary lipids and vitamins (A & E) (Jenkins and Atwal, 1994). Saponins cause bloat, hemolysis, GIT erosion, inhibit enzyme action. The bitter taste of saponin is the major factor that limits its use. Saponins were found to reduce the bioavailability of nutrients and decrease enzyme activity and it affects protein digestibility by inhibit various digestive enzyme such as trypsin and chymotrypsin (Simee, 2011)

Nitrates

Animal feed, especially forage, typically contains nitrate as one form of nitrogen. In normal conditions, nitrate in feed is generally negligible (Leng, 2008) and not a concern for ruminants. However, under certain circumstances, relatively large quantities of nitrate can accumulate in plants, and when consumed by ruminants, may cause poisoning.

There are several major factors causing nitrate poisoning (Leng 2008): (1) nitrate levels in the diet, (2) nitrate consumption rate, (3) incomplete nitrate and nitrite reduction to ammonia in the rumen, and (4) slow rumen passage rate (e.g., longer nitrate or nitrite retention in the rumen). Depending on those factors, ruminants can be poisoned by nitrate in feed with the poisoned animals manifesting symptoms depending on the degree of nitrate poisoning, such as depressed feed intake and production, no weight gain, susceptibility to infection, reproductive failure, brown mucous membrane discoloration, respiratory distress, coma, cyanosis, and even death.

Oxalate

In ruminants oxalic acid is of only minor significance as an anti-nutritive factor since ruminal microflora can readily metabolize soluble oxalates (Habtamu and nigusse, 2014). Various tropical grasses contain soluble oxalates in sufficient concentration to induce calcium deficiency in grazing animals. These include buffel grass (*Cenchrus ciliaris*), pangola grass (*Digitaria decumbens*), setaria (*Setaria sphacelata*) and kikuyugrass (*Pennisetum clandestinum*). Oxalates react with calcium to produce insoluble calcium oxalate, reducing calcium absorption. This leads to a disturbance in the absorbed calcium: phosphorus ratio, resulting in mobilization of bone mineral to alleviate the hypocalcemia. Prolonged mobilization of bone mineral results in nutritional secondary hyperparathyroidism or osteodystrophy fibrosa (Rahman and Kawamura, 2011). Cattle and sheep are less affected because of degradation of oxalate in the rumen. However, cattle mortalities from oxalate poisoning due to acute hypocalcemia have occurred on setaria pastures and sheep have been poisoned while grazing buffel grass. Levels of 0.5 per cent or more soluble oxalate in forage grasses may induce nutritional hyperparathyroidism in horses. Levels of 2 per cent or more soluble oxalate can lead to acute toxicosis in ruminants.

In general, oxalate poisoning is a complex issue. Induction of acute oxalate intoxication depends on several factors including the chemical form of oxalate, the age of animal, the rate of consumption, the amount and quality of other feed consumed concurrently, the total amount of oxalate consumed and adaptation to a diet containing oxalate (Radositits *et al.*, 2007). Dietary oxalate, if consumed in large quantities, is well known to have potential toxicity (Sidhu *et al.*, 1996). The rumen is overwhelmed and unable to metabolize the oxalate, which is absorbed into the blood. “In the blood, the oxalate forms an insoluble salt that precipitates in the kidney, causing kidney failure.

Cyanogens

Cyanogens are glycosides of a sugar or sugars and cyanide containing aglycone. It can be hydrolysed to release HCN by enzymes that are found in the cytosol. Damage to the plant occurs when the enzymes and glycoside form HCN. The hydrolytic reaction takes place in the rumen by microbial activity. In pig and horse, enzyme concerned in the release of HCN is destroyed by the gastric HCl. Hence, ruminants are more susceptible to cyanide than monogastric animals (Smitha *et al.*, 2013). The HCN is absorbed and is rapidly detoxified in the liver by the enzyme rhodanese which converts CN to thiocyanate (SCN). Excess cyanide ion inhibits the cytochrome oxidase. This stops ATP formation, tissues suffer energy deprivation and death follows rapidly. The lethal dose of HCN for cattle and sheep is 2.0-4.0 mg per kg body weight (Sarah robson, 2007).

Phytate

Phytate, which is also known as inositol hexakisphosphate, is a phosphorus containing compound that binds with minerals and inhibits mineral absorption. The cause of mineral deficiency is commonly due to its low bioavailability in the diet. The presence of phytate in feeds has been associated with reduced mineral absorption due to the structure of phyate which has high density of negatively charged phosphate groups which form very stable complexes with mineral ions causing non-availability for intestinal absorption (Walter *et al.*, 2002). Phytates are generally found in feed high in fibre especially in wheat bran, whole grains and legumes.

Alkaloids

Alkaloids are one of the largest groups of chemical compounds synthesised by plants and generally found as salts of plant acids such as oxalic, malic, tartaric or citric acid. The chemical type of their nitrogen ring offers the means by which alkaloids are sub classified: for example, glycoalkaloids (the aglycone portion) glycosylated with acarbohydrate moiety. They are formed as metabolic by products. Insects and hervibores are usual1y repulsed by the potential toxicity and bitter taste of alkaloids. Alkaloids are considered to be anti-nutrients because of their action on the nervous system, disrupting inappropriately augmenting electrochemical transmission. For instance, consumption of high tropane alkaloids will cause rapid heartbeat, paralysis and in fatal case, lead to death. Uptake of high dose of tryptamine alkaloids will lead to staggering gate and death. Indeed, the physiological effects of alkaloids have on humans are very evident (Habtamu and nigusse, 2014).

Protease Inhibitors

Protease inhibitors are widely distributed within the plant kingdom, including the seeds of most cultivated legumes and cereals. Protease inhibitors are the most commonly encountered class of ant nutritional factors of plant origin. Protease inhibitors have the ability to inhibit the activity of proteolytic enzymes within the gastrointestinal tract of animals. Due to their particular protein nature, protease inhibitors may be easily denatured by heat processing although some residual activity may still remain in the commercially produced products. The antinutrient activity of protease inhibitors is associated with growth inhibition and pancreatic hypertrophy (Chunmei *et al.*, 2010).

Protease inhibitors are small protein molecules that can interfere with the action of the proteolytic enzymes involved in breaking down protein into amino acid components. Inhibitors have been isolated from many legumes, including soybeans, and they can be destroyed by heat, which is why whole soybeans must be roasted before they can be included in poultry diets (Jacob, 2015). For maximum conversion of the proteins of soybeans and other legumes into products with good nutritional quality, the conditions of heat treatment must inactivate the antinutritional substances as well as transform the raw protein into a more bird-available digested form (Rackis *et al.*, 2014). Protease inhibitors are limiting factors for protein digestibility and growth performance (Jacob, 2015).

Mycotoxins

Mycotoxins are toxic secondary metabolites produced by fungi (molds) toxic to humans, livestock and plants. Their ingestion, inhalation or dermal absorption may cause different diseases and even death. Mycotoxins are undesirable, but mostly unavoidable, mold produced feed contaminants. Mycotoxins are in general stable and capable of persisting into final products (Sabater Vilar, 2003).

Mycotoxins impair ruminal functions by exerting antimicrobial effects on rumen micro flora. Increased rate of passage of feed through the rumen may possibly overwhelm the ability of the rumen to completely denature the toxins (Fink-Gremmels, 2008). Ruminant’s diet generally includes both forages and concentrates (Azam *et al.*, 2009) and may have an increased probability of multiple mycotoxins contamination. Mycotoxins can cause damage to organ systems, reduce production and reproduction, and increase diseases by reducing immunity. Some mycotoxins are carcinogens, some target liver, kidney, digestive tract or the reproductive system (Akande *et al.*, 2006)

Gossypol

Gossypol pigment in cottonseed occurs in free and bound forms. Free gossypol is the toxic entity and causes organ damage, cardiac failure and death. Cottonseed meal fed to bulls can induce increased sperm, abnormalities and decreased sperm production. Cottonseed includes sufficiently high gossypol concentrations to produce acute poisoning. However, there are cumulative effects of dietary gossypol and toxicity which can occur following an ingestion period of one to three months. Young ruminants are more sensitive to gossypol compared with adult ruminants because gossypol is not bound during ruminal fermentation, as it occurs in animals with fully functional rumens (Soto-Blanco, 2008). Numerous researchers have reported that high levels of gossypol in broilers depressed weight gain (Waldroup, 1981) and feed efficiency (Couch et al., 1955). Furthermore, several factors influence the tolerance of gossypol for animals. These factors include the source of CSM, dose or concentration of CSM, the processing technique the CSM has been subjected to, the level of nutrients in the diet, age of birds, animal type or species, and dietary iron and lysine (Nagalakshmi *et al.*, 2007).

Methods of Mitigation of Antinutritional Factors

The abundance of anti-nutritional factors and toxic influences in plants used as animal feeds certainly calls for concern. Therefore, ways and means of eliminating or reducing their levels to the barest minimum should be discovered (Soetan and Oyewole, 2009**)**. Removal of undesirable components is essential to improve the nutritional quality of legumes and effectively utilize their full potential as animal feed. It is widely accepted that simple and inexpensive processing techniques are effective methods of achieving desirable changes in the composition of seeds (Akande and Fabiyi, 2010). Soaking, dehulling, cooking germination and fermentation are important traditional methods used to reduce antinutrients (Abdelrahaman *et al.*, 2005).

Alonso *et al.*, (2000) reported the effects of extrusion and traditional processing methods on antinutrients and in vitro digestibility of protein and starch in faba and kidney beans. Dehulling significantly increased protein content and greatly reduced condensed tannin and polyphenol levels in both legumes. Extrusion was the best method to abolish trypsin, chymotrypsin, amylase inhibitors and haemagglutinating activity without modifying protein content. Furthermore, this thermal treatment was most effective in improving protein and starch digestibilities when compared with dehulling, soaking and germination.

Osman (2007) reported that roasting caused greater reduction (60.69%) on phytic acid followed by autoclaving (52.29%), germination (48.94%) and cooking (44.85%), while soaking showed the lowest reduction (22.19%). Reduction in the phytic acid content during soaking, cooking or germination has been reported by many investigators (Vidal-Vilverde *et al.*, 1994; Aloso *et al.*, 1998, 2000) for Chinese legumes, pea, faba bean, dry bean, lentil and black bean, respectively.

Ogundipe *et al.*, (2003) reported that cooking had significant effects on the utilization of Lablab purpureus beans by pullet chicks. Cooking lablab seeds for about 30 min gave the best results in terms of final weight, weight gain, feed consumption and feed-gain ratio.

Omeje (1999) reported also that cooking of legume seeds for about 30 min resulted in the destruction of the anti-nutritional factors such as trypsin inhibitors, haemagglutinins, phytic acids, lectins and goitrogens, thereby improving the nutrient availability for better performance of the bird fed such diets.

Omoruyi *et al.*, (2007) concluded that boiling and roasting were effective in lowering the levels of anti-nutritional factors. Ikemefuna *et al.*, (1991) reported the effects of soaking, sprouting, cooking and fermentation on some nutrient composition and anti-nutrients factors of sorghum seeds. They reported that a combination of cooking and fermentation improved the nutrient quality and drastically reduced the anti-nutritional factors to safe levels much greater than any of the processing methods tested.

Genetic modification technique can be used efficiently to reduce phytic acid content in cereals by cloning the genes of phytase enzyme and by creating the transgenic plant with modified genome encoding for phytase enzyme.

Table.1 Plant toxins: sources and concentrations

Toxin	Principal sources	Typical concentrations
Lectins	Jackbean	3 units/mg protein
	Winged	40-320 units/mg
	lima beans	59 units/mg protein
Trypsin inhibitors	Soybean	88 units/mg
Antigenic proteins	Soybean	-
Cyanogens	Cassava root	186 mg HCN/kg
Condensed tannins	Acacia spp.	65 g/kg
	Lotus spp.	30-40 g/kg
Quinolizidine alkaloids	Lupin	10-20g/ kg
Glusosinolates	Rapeseed	100 mmol/kg
Gossypol	Cottonseed	0.6-12 g/kg (free)
Saponins (steroidal) Brachiaria decumbens;	Panicum spp.	-
S methyl cysteine sulphoxide	Kale	40-60 g/kg
Mimosine	Leucaena leucocephala	25 g/kg (leaf) 145 g/kg (seed)
Phyto oestrogens	Clover; Lucerne, soybean	

Source: Compiled from D'Mello *et al*, 1995

Table.2 Some examples of anti-nutritional effects of tannins in shrub and tree forages.

Fodder Tree/Shrub	Predom-inant Tannin*	Animal	Nutritional Effect	References
Acacia aneuraa	CT	Sheep	Reduction in N digestibility decreased wool yield and growth, decreased S absorption	Pritchard *et al.* (1988)
A. cyanophylla	CT	Sheep	Reduced feed intake, negative N digestibility, loss in weight	Reed *et al.* (1990)
***A. nilotica* (pods)**	CT	Sheep	Low growth rate, reduced N and NDF digestibility	Tanner *et al.* (1990)
***A. sieberianab* (Pods)**	HT	Sheep	Low growth rate, reduced N and NDF digestibility	-
Albizia chinensis	CT	Goat	Reduced *in sacco* N digestibility	Ahn *et al.* (1989)
Leucaena leucocephala	CT	Poultry	Poor N retention, low apparent metabolisable energy value	D'Mello and Acamovic (1989)
Prosopis cineraria	CT	Sheep	Reduction in feed intake protein, digestibility, decreased wool yield & growth, decreased iron absorption	CSWRI (1989)
Terminalia oblongata	HT	Sheep	Reduction in feed intake, toxicity but no effect upon digestibility	McSweeney *et al.* (1988)
Ziziphus nummularia	CT	Sheep	Reduction in feed intake protein and DM digesti-bility; decreased wool yield and weight loss	Kumar and Vaithiya- nathan (1990)

* CT- Condensed Tannins; HT- Hydrolysable Tannins

Table.3 Level of nitrate in forage (dry matter basis) and potential effects on animals

Content of Nitrate nitrogen (ppm)	Effect on animals
0-1000	This level is considered safe to feed under all conditions
1000-1500	This level should be safe to feed to non pregnant animals under all Conditions. It may be best to limit its use to pregnant animas to 50 per cent of the total ration on a dry basis.
1500-2000	Feeds are fed safely if limited to 50 per cent of ration's total dry matter.
20000-3500	Feeds should be limited to 35-40 per cent of total dry matter in the ration. Feeds containing over 2000 ppm nitrate nitrogen should not be used for pregnant animals
3500-4000	Feeds should be limited to 25 per cent of total dry matter in ration. Do not use for pregnant animals.
>4000	Feeds containing over 4000 ppm are potentially toxic. Do not feed.
	Source (John Andrae, 2008)

Table.4 Content of phytic acid in major cereals, legumes, oilseeds and nuts

Name	Phytic acid g/100 g(dw)	References
Cereals		
Maize germ	6.39	Kasim and Edwards 1998
Wheat bran	2.1–7.3	Harland and Oberleas 1986; Wise 1983
Wheat germ	1.14–3.91	Wise 1983
Rice bran	2.56–8.7	Kasim and Edwards 1998; Lehrfeld 1994
Barley	0.38–1.16	Kasim and Edwards 1998
Sorghum	0.57–3.35	Kasim and Edwards 1998
Oat	0.42–1.16	Harland and Oberleas 1986
Rye	0.54–1.46	Harland and Prosky 1979
Millet	0.18–1.67	Lestienne et al. 2005
Legumes		
Kidney beans	0.61–2.38	Lehrfeld 1994
Peas	0.22–1.22	Ravindran et al. 1994
Chickpeas	0.28–1.60	Ravindran et al. 1994
Lentils	0.27–1.51	Ravindran et al. 1994
Oilseeds		
Soybeans	1.0–2.22	Lolas et al. 1976
Linseed	2.15–3.69	Wise 1983
Sesame seed	1.44–5.36	Harland and Oberleas 1986
Sunflower meal	3.9–4.3	Kasim and Edwards 1998
Nuts		
Peanuts	0.17–4.47	Venktachalam and Sathe 2006
Almonds	0.35–9.42	Harland and Oberleas 1986
Walnuts	0.20–6.69	Chen 2004
Cashew nuts	0.19–4.98	Chen 2004

Source :- Schlemmer *et al.* 2009)

Table.5 Mycotoxins and their effect on different livestock species.

Mycotoxins	Species susceptibility	Effects
Aflatoxins	All domestic animals and poultry	Hepatoxic,carcinogenic, immune suppressive
Zearalenone	Mainly pigs and dairy animals	Estrogeni and reproductive disorder
Vomitoxin	Mainly pigs and dairy animals	Dermatotoxic, feed refusa
Ochratoxin	Mainly pigs and poultry	Nephrotoxic, gout
T-2 Toxin	Mainly pigs and poultry	Mouth lesions, loss of appetite
Fumonisins	Mainly pigs and horses	Neurological disorders, liver damage

Source: (Ratcliff, 2002).

Genetic modification of crop plants for production of heterologous phytase reduces phosphate load on agricultural ecosystems as well as improving phosphate bioavalability (Brinch-Pedersen *et al.*, 2002; Vats and Banerjee 2004). Biotechnology employs breeding techniques to eliminate the undesirable components from the beans. Such an approach requires long-term studies depending on the type and number of the undesirable components (Deshpande, 2002).

The anti-nutritional factors substances generated in natural feed stuffs by the normal metabolism of species and by different mechanisms which exert effects contrary to optimum nutrition and interfere with feed utilization and affect the health and performance of animals.

By employing appropriate and effective processing techniques or combination of techniques could help reduce antinutritional level.

Way forward

By Employing appropriate and effective processing techniques or combination of techniques reduce or eliminate the adverse effects of ant nutritive constituents in plant protein sources and thereby improve their nutritive value.

Supplement some minerals, amino acids and vitamins reduce or neutralize the negative effect of antinutritional factors in plant protein sources for livestock nutrition.

Feed block, a solidified blend of agro-industrial by-products, was found to be an efficient supplement for increasing intake, rumen fermentation, digestibility and daily weight gain in sheep or goats fed on shrub foliage high in tannins. Polyethylene glycol supplying to animals on tannin-rich diets in different ways (in concentrate or feed blocks, dissolved in water, or sprayed on feed).

References

Abdelrahaman, S. M., El Maki, H. B., Babiker, E. E., El Tinay, A. H. 2005. Effect of malt pretreatment followed by fermentation on antinutritional factors and HCl- Extractability of minerals of pearl millet cultivars. Journal of Food Technology, 3, 529-534.

Ahn., J. H., Robertson, B. M., Elliot, R., Gutterridge, R. C. and Ford C. W. 1989. Quality Assessment of Tropical Browse legumes: Tannin content and protein degradation. Animal Feed Science and Technology 27: 147–156.

Akande K. E. and E. F. Fabiyi, 2010. Effect of Processing Methods on Some Anti-nutritional Factors in Legume Seeds for Poultry Feeding. International Journal of Poultry Science 9 (10): 996-1001, 2010, ISSN 1682-8356.

Akande K. E., U. D. Doma, H. O. Agu and H. M. Adamu. 2010. Major Antinutrients Found in Plant Protein Food Science and Quality Management ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online) Vol.36, 2015 Sources: Their Effect on Nutrition. Pakistan Journal of Nutrition 9 (8): 827-832, 2010, ISSN 1680-5194.

Alonso R, Aguirre A, Marzo F 2000. Effect of traditional processing methods on antinutritionals and in vitro digestibility of protein and starch in faba and kidney beans. Food Chem. 68: 159-165.

Alonso R, Orue C, Marzo F (1998). Effect of extrusion and conventional processing methods on protein and antinutritional factor content in pea seeds. Food Chem. 63: 505-512.

Azam M B, Z H Khan, S Yaqoob, R A Khan 2009. Nature and extent of problems of agrograziers in Bhawalpur district, Pakistan. Pakistan Vet. J., 29(1): 32

B. Soto-Blanco 2008. “Gossipol e fatores antinutricionais da soja,” in Toxicologia

Aplicada a MedicIna VeterIn ` aria ´, H. S. Spinosa, S. L. Gorniak, and J. P. Neto, Eds., pp. 531–545, Manole, Barueri, ´ Brazil

Brinch-Pedersen H, Sorensen LD, Holm PB. 2007. Engineering crop plants: getting a handle on phosphate. Trends Plant Sci. 2002;7:118–125. doi: 10.1016/S1360-1385(01)02222-1. [PubMed] [CrossRef]

Chen Q C. 2004. Determination of phytic acid and inositol pentakis phosphate in foods by HPLC. Agric Food Chem 52:4604–4613CSWRI 1989

Chunmei G., P. Hongbin, S. Zewei and Q. Guixin, 2010. Effect of Soybean Variety on Anti-Nutritional Factors Content, and Growth Performance and Nutrients Metabolism in Rat. Int. J. Mol. Sci. 2010, 11, 1048-1056; doi:10.3390/ijms11031048. ISSN 1422-0067 condensed tannins. J. Anim. Sci. 83, 1322–1331

Couch J. R., Chang W. Y., Lyman C. M. 1955. The effect of free gossypol on chick growth. Poult. Sci;34:178–183.

CSWRI. 1989. Processing of tannin feeds for their increased utilization. Report. Central Sheep & Wool Research Institute, Avikanagar, India 304501.

D’Mello, J. P. F., 2000. Antinutritional factors and mycotoxins. In J. P. F. D’Mello, ed. Farm animal metabolism and nutrition. Wallingford, UK, CAB International, p: 383-403

Deshpande S. S. 2002. Handbook of food toxicology pp 370-378

D'Mello, D. A., Finkbeiner, D. S. and Kocher, K. N., 1995. The cost of antidepressant overdose. General Hospital Psychiatry, 17(6), pp.454-455.

D'Mello, J. P. F. and Acamovic, T. 1989. Leucaena leucocephala in poultry nutrition: A Review. Animal Feed Science and Technology 26: 1–28.

Fink-Gremmels J 2008. “The role of mycotoxins in the health and performance of dairy cows” The Veterinary Journal, vol. 176: Pp. 84-92

Habtamu Fekadu and Negussie Ratta, 2014. Antinutritional factors in plant foods: Potential health benefits and adverse effects. International Journal of Nutrition and Food Sciences, 2014; 3(4): 284-289. Published online July 20, 2014 (http://www.sciencepublishinggroup.com/j/ijnfs) doi: 10.11648/j.ijnfs.20140304.18. ISSN: 23272694 (Print); ISSN: 2327-2716 (Online)

Harland B F, Oberleas D 1986 Anion-exchange method for determination of phytate in foods-collaborative study. J Assoc Off Anal Chem 69:667–670

Harland B F, Prosky L D 1979 Development of dietary fibre values for foods. Cereal Foods World 24:387–394

Huisman, J. & Tolman, G. H., 2001. Antinutritional factors in the plant proteins of diets for nonruminants. Recent Developments in Pig Nutrition, 3, 261-291, Netherlands.

Ikemefuna C, Obizoba J, Atii J V 1991. Effects of soaking, sprouting, fermentation and cooking on nutrient composition and some antinutritional factors of sorghum (Guinesia) seeds. Plant Foods for Hum. Nutr., 41: 203-212.

Jacob, J. 2015. “Antinutritional Factors in Feed Ingredients”. University of Kentucky. eXtension. extension.org.

James, L. F.; Butcher, J. E., 1972: Halogeton poisoning of sheep: effect of high level oxalate intake. Journal of Animal Science 35, 1233–1238.

Jenkins, K. J. and A. S. Atwal, 1994. Effects of dietary. saponins on faecal bile acids and neutral sterols and availability of vitamins A and E in the chick. J.Nutr. Biochem., 5: 134-137.

John Andrae, 2008, Preventing prussic acid poisoning. Forage Leaflet, 13, Clemson University.

Kasim A B, Edwards H M J 1998. The analysis of inositol phosphate forms in feed ingredients. Sci Food Agric 76:1–9

Kasim and Edwards 1998. Mycotoxins in Agriculture and Food Safety, Marcel Dekker Inc.,, pp. 227–253.

Kumar, R., Vaithiyanathan, S. 1990. Occurrence, nutritional significce and effect on animals of tannins in tree leaves. Anim. Feed Sci. Technol. 30: 2123.

Le Bourvellec, C., Renarda, C. M. G. C., 2012. Interactions between Polyphenols and Macromolecules: Quantification Methods and Mechanisms. Critical Reviews in Food Science and Nutrition 52, 213-248.

Lehrfeld J. 1994. HPLC separation and quantitation of phytic acid and some inositol phosphates in foods: problems and solutions. J Agric Food Chem 42:2726–2731

Leng R. A. 2008. The potential of feeding nitrate to reduce enteric methane production in ruminants. Report to Department of Climate Change, Commonwealth Government, Canberra. [Online] Available: http://www.penambulbooks.com/Downloads/ Leng-Final Modified 17-9-2008.pdf [2010 Jul. 17].

Lestienne I, Caporiccio B, Besancon P, Rochette I, Treche S. 2005. Relative contribution of phytates, fibers and tannins to low iron and zinc in vitro solubility in pearl millet (*Pennisetum glaucum*) flour and grain fractions. J Agric Food Chem 53:8342–8348

Lolas G M, Palamidids N, Markakis P. 1976. The phytic acid—total phosphorus relationship in barley, oats, soybeans and wheat. Cereal Chem 53:867–871

McSweeney, C., Kennedy, P., John, A., 1988. Effect of ingestion of hydrolysable tannins in Terminalia oblongata on digestion in sheep fed Stylosanthes hamata. Australian Journal of Agricultural Research 39, 235244.

Nagalakshmi D., Savaram V. R., Arun K. P., Vadali R. B. 2007. Cottonseed meal in poultry diets: A review. Jpn. Poult. Sci. 2007;44:119–134.

Ogundipe S O, Abeke F O, Sekoni A A, Dafwang I I, Adeyinka I A. 2003. Effects of cooking duration on the utilization of Lablab purpureus beans by pullet chicks. Proc. 28th Annual Conf. Niger. Soc. Animal Product.

Omeje S K.1999. Issues in Animal science. Raykennedy Scientific Publication, Enugu, Nigeria.

Omoruyi F O, Dilworth L, Asemota H N. 2007. Antinutritional factors, zinc, iron and calcium in some Caribbean tuber crops and the effect of boiling or roasting. Nutr. Food Sci., Vol. 37(1): 8-15.

Osman A M 2007. Effect of different processing methods on nutrient composition, anti-nutritional factors and in vitro protein digestibility on Dolichos lablab bean (*Lablab purpureus* (L) Sweet). Pak. J. Nutr. 6(4): 299-303.

Pritchard, D. A., Stocks, D. C., O'Sullivan, B. M., Martin, P. R., Hurwood, I. S. and O'Rourke, P. K. 1988. The effect of polyethylene glycol (PEG) on wool growth and live weight of sheep consuming Mulga (*Acacia aneura*) diet. Proceeding of Australian Society of Animal Production 17: 290–293.

Rackis, J., Gumbmann, R. 2014. “Protease Inhibitors: Physiological Properties and Nutritional Significance” Northern Regional Research Center Agricultural Research Science and Education Administration. USDA

Radositits, O. M.; Gay, C. C.; Hinchcliff, K. W.; Constable, P. D., 2007: Veterinary Medicine, 10th edn. SaundersElsevier, London

Rahman, M. M. and Kawamura, O., 2011, Oxalate accumulation in forage plants: some agronomic, climatic and genetic aspects. Asian Aust. J. Anim. Sci., 24(3): 439-448.

Ratcliff J. 2002. The role of mycotoxins in food safety and feed safety. Presented at AFMA (Animal feed manufacturers association) on the 16th August, 2002.

Ravindran, V., Ravindran, G. and Sivalogan, S., 1994. Total and phytate phosphorus contents of various foods and feedstuffs of plant origin. Food Chemistry, 50(2), pp.133-136.

Reed J D, Solar H, Wood Ward A. 1990. Foder tree and straw diets for sheep: intake, growth, digestibility and the effect of phenolics on nitrogen utilization. Anim Feed Sci Technol. ;30(1–2): 39–50.

Sabater Vilar M. 2003. Assessment and Intervention of Food- and Feed-borne mycotoxicoses. Dissertation University of Utrecht, Faculty of Veterinary Medicine, Departement of Veterinary Pharmacology, Pharmacy and Toxicology.

Sarah Robson, 2007, Prussic acid poisoning in Livestock. www.dpi.nsw.gov.au/ Prime facts

Sidhu, P. K.; Joshi, D. V.; Srivastava, A. K., 1996: Oxalate toxicity in ruminants fed overgrown napiergrass (*Pennisetum purpureum*). Indian Journal of Animal Nutrition 13, 181–183.

Simee W. 2011. Isolation and determination of antinutritional compounds from root to shells of peanut (*Arachis hypogaea*). J. Disper. Sci. Technol. 28:341-347

Smitha Patel P. A., S. C. Alagundagi and S. R. Salakinkop, 2013. The anti-nutritional factors in forages - A review. Current Biotica 6(4): 516-526, 2013, ISSN 0973-4031

Soetan K. and Oyewol O. 2009. The need for adequate processing to reduce the antinutritional factors in plants used as human foods and animal feeds: A review. African Journal of Food Science Vol. 3 (9), pp. 223-232.

Soetan K O. 2008. Pharmacological and other beneficial effects of antinutriional factors in plants. –A Review. Afr. J. Biotechnol. 7(25): pp 4713-4721.

Tanner, J. C., Reed, J. D. and Owen, E. 1990. The nutritive value of fruits (pods with seeds) from four Acacia spp. compared with nong (*Guizotia abssinica*) meal as supplements of maize stover for Ethiopian high land sheep. Animal Production 51: 127–133.

Ugwu, F. M. and Oranye, N. A. 2006. Effects of some processing methods on the toxic components of

African breadfruit (*Treculia qfricana*). African Journal 0/Biotechnology 5,2329-2333.

Vats P, Banerjee U C. 2004. Production studies and catalytic properties of phytases (myo-inositol-hexakis-phosphate phosphohydrolases): an overview. Enzyme Microb Technol. 2004;35:3–14. doi: 10.1016/j.enzmictec.03.010. [CrossRef]

Venktachalam M, Sathe S K.2006. Chemical composition of selected edible nut seeds. J Agric Food Chem 54:4705–4714

Vidal-Valverde C, Frias J, Estreella I, Gorospe J M, Ruiz R Bacon J. 1994. Effect of processing on some antinutritional factors of lentils. J. Agric Food Chem. 42: 2291-2295.

Waldroup P. W. Cottonseed meal in poultry diets. Feedstuffs. 1981;53:21–24.

Walter, H. L, L., Fanny, C., Charles & R., Christian. 2002. Minerals and phytic acid interaction: is it a real problem for human nutrition. Int J Food Sc Tech 37: pp 727-739. weights and liver functions of albino rats. Int. J. Natural and Appl. Sci.

Wise A. 1983. Dietary factors determining the biological activities of phytase. Nutr Abstr Rev 53:791–806

How to cite this article:

Chala Edea. 2022. Anti-Nutritional Factors in Livestock Feed, Effect on Animal Performance and Methods of Mitigation. A Review. *Int.J.Curr.Res.Aca.Rev*. 10(04), 119-129. doi: https://doi.org/10.20546/ijcrar.2022.1004.010