

Compilation of Research on Tannin Ingestion and the Affects of Tannin Consumption when feeding animals.

What are Tannins?

Tannins are water soluble polyphenolic compounds that can be divided into two main groups: condensed tannins (CT) and hydrolysable tannins (HT) ¹. Hydrolysable tannins consist of a carbohydrate core whose hydroxyl groups are esterified with phenolic acids. They are polyesters formed out of phenolic acids, mostly gallic acid, and a sugar molecule. The CT (polyanthocyanidins); are non-branched polymers of flavonoid phenol units (mostly catechin), linked by monomers ²and they belong to the group of secondary plant metabolites (PSM)³.

Affects of Tannin Consumption

The fact that the tannins bind to proteins, leads in general to an inhibition of the digestion and thereby the utilization of nutrients by the host.⁴

The effect on feed intake can either be short-term or long-term. Tannins are known to cause astringency on the epithelium of the oral cavity and the oesophagus. These effects are short-term, which means that they last for 20 to 60 minutes. The long-term effects can last for days or weeks and are correlated to a decrease in the levels of ammonia and/or volatile fatty acids (VFA)⁵. Both types of effects cause a reduction on feed intake, depending on the percentage of CT in forage.

For both CT and HT, the working mechanisms to explain decreased feed intake seem to be: a) a reduction in feed palatability; b) a reduction in rate of digestion (due to the slower passage rate of digesta in the gut, to give more time to host enzymes to extract nutrients, with the feedback loop for satiety being delayed); or c) the development of accustomed aversions.

The presence of CT, reduces protein availability for absorption. Not only by forming complexes with them, but also by limiting ruminal microbial growth and lowering the fractional absorption of amino acids from the intestine⁶

¹ (Haslam, 1988; Fickel et al., 1997; Frutos et al., 2004)

² (Mueller-Harvey and McAllan, 1992; Mueller-Harvey, 1999; Seresinhe and Pathirana, 2003)

³ (Iason, 2005; Waghorn, 2008)

⁴ (Martin et al., 1987; Haslam, 1988; Makkar et al., 1995)

⁵ (Silanikove et al., 2001)

⁶ (Waghorn, 2008)

As tannins are able to form complexes with cell wall carbohydrates, they can reduce cell wall digestibility⁷ Sheep fed with *Albizia cyanophylla* (high in CT content) showed the lowest digestibility of fibre fractions and organic matter. Tannin levels of 5-9% lead to a reduction of the ruminal digestibility of fibre⁸. This occurs because of the inhibiting effect that tannins have on the activity of bacteria and anaerobic fungi⁹.

Hervás et al. (2003) studied pathological effects at different concentrations of Quebracho tannin powder, containing 760 g CT/kg. The authors found macroscopically visible lesions in the ruminal mucosa at a CT concentration of 2.28 g/kg bodyweight. These lesions were small ulcers (approximately 0.5-3mm) that were scattered over the entire ruminal wall (mainly ventral).

According to Brooker et al. (2000) tannins are able to inhibit the uptake of nutrients in the abomasum and the intestine of ruminants.

Consuming high levels of tannins can give toxic effects and can even be fatal¹⁰

Studies with goats consuming tannins showed the goats had an average decrease of 2.08 kg (or 8% of the initial body weight) during the testing period.¹¹

Tannins are grouped, based on their chemical structure, into either condensed or hydrolysable tannins. **Olive pulp** contains condensed tannins based on literature reports.

The concern about condensed tannins is that their consumption by animals, typically referring to non-human animals, has been associated with damage to the liver, kidneys and gastro-intestinal tract.

Despite major structural differences, hydrolyzable and condensed tannins often produce similar anti-nutritional effects. The most common effects are diminished weight gains and lowered efficiency of nutrient utilization¹²

Hydrolyzable tannins are potentially toxic to ruminants. Pyrogallol, a hepatotoxin and nephrotoxin, is a product of HT degradation by ruminal microbes. Proanthocyanidins are considered to be non-toxic because they are not absorbed, but they are associated with lesions of the gut mucosa.¹³

⁷ (Reed et al., 1990).

⁸ (Reed et al., 1985)

⁹ (Chesson et al., 1982)

¹⁰ (Garg et al., 1992; Makkar, 2003)

¹¹ https://lib.ugent.be/fulltxt/RUG01/002/376/765/RUG01-002376765_2017_0001_AC.pdf

¹² Antinutritional effects of condensed and hydrolyzable tannins. Butler LG. Basic Life Sci. 1992.

¹³ Nutritional toxicology of tannins and related polyphenols in forage legumes. JD. Reed.

Some phenolic compounds (e.g. coumestans) cause temporary infertility, whilst those produced by *Fusarium* fungi found in pasture, silage or stored grains can cause permanent infertility. The Hydrolysable Tannins may be toxic because products of their metabolism can cause liver damage and other metabolic disorders.¹⁴

It was concluded that tannic acid can exert a negative effect both on rumen degradation and on intestinal digestion of Soy Bean Meal ¹⁵

Narjisse et al. (1995) infused tannins directly into the rumen to determine whether factors independent of palatability were responsible for the reduction in voluntary feed intake. Slowing the digestion of dry matter in the rumen impairs the emptying of the digestive tract, generating signals that the animal is 'full' and providing feedback to the nerve centers involved in intake control. In agreement with some authors, this could influence voluntary feed intake more than a reduction of palatability¹⁶

Tannins are toxic to liver and kidneys ¹⁷

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¹⁴ Consequences of plant phenolic compounds for productivity and health of ruminants. GC Waghorn 2003

¹⁵ Effect of tannic acid on rumen degradation and intestinal digestion of treated soya bean meals in sheep [G. HERVÁS](#) ^(a1), [P. FRUTOS](#) ^(a1), [E. SERRANO](#) ^(a1), [A. R. MANTECÓN](#)

¹⁶ 194 P. Frutos et al. / Span J Agric Res (2004) 2 (2), 191-202

¹⁷ cSweeney, C.S., Kenedy, P.M. and 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, 235-244

