Behavior of tannin-protein complexes in ruminant digestive tract: influence of pH on protein precipitation capacity of oak or chestnut tannins

Herremans S.[1], Decruyenaere V.[1], Beckers Y.[2], Froidmont E.[1]

[1]Walloon Agricultural Research Centre, Production and Sectors Department, Belgium

[2]University of Liège, Gembloux AgroBio-Tech, Precision Livestock and Nutrition, Belgium

Contact : s.herremans@cra.wallonie.be

Background

According to several authors, tannins form complexes with proteins making them less susceptible to lysis (Piluzza et al., 2014). These complexes are thought to dissociate at low pH (Jones & Mangan, 1977) in the abomasum which would allow a larger supply of digestible proteins in the intestine and could thus lead to higher N use efficiency.

Objective

To determine the dissociation pH thresholds of complexes made of hydrolysable tannins and soluble proteins.

Method

A protein precipitation capacity (PPC) assay quantified tannin and protein complexation by measuring uncomplexed N (still soluble after tannin addition in a protein solution) compared to initial N (method adapted from Amory & Schubert, 1987). After correction for naturally precipitated proteins, the part of precipitated N was considered as complexed with tannins. The effect of varying pH (from 1.5 to 9) on protein precipitation was assessed by adding NaOH or HCl solutions.

Exp 1: 0.5g Oak tannins + bovine serum albumin (BSA)
0.1g Oak tannins + casein

Exp 2: 0.9g Oak tannins + Pea protein extract
0.9g Oak tannins + Soybean protein extract
0.9g Chestnut tannins + Pea protein extract
0.9g Chestnut tannins + Soybean protein extract

Results

- Hydrolysable tannins were able to complex with 4 kinds of proteins, from animal or plant origin.
- Oak and chestnut tannins had similar complexation properties in presence of pea and soybean proteins.
- Neutral and alkaline pH caused partial or complete dissociation according to protein nature.
- No dissociation was observed with plant proteins at acidic pH, at least until pH 1.6.
- At the ruminal pH (6-7), 40 to 80% of plant proteins were precipitated by tannins. Small changes in ruminal pH can have major impacts on tannin effect.

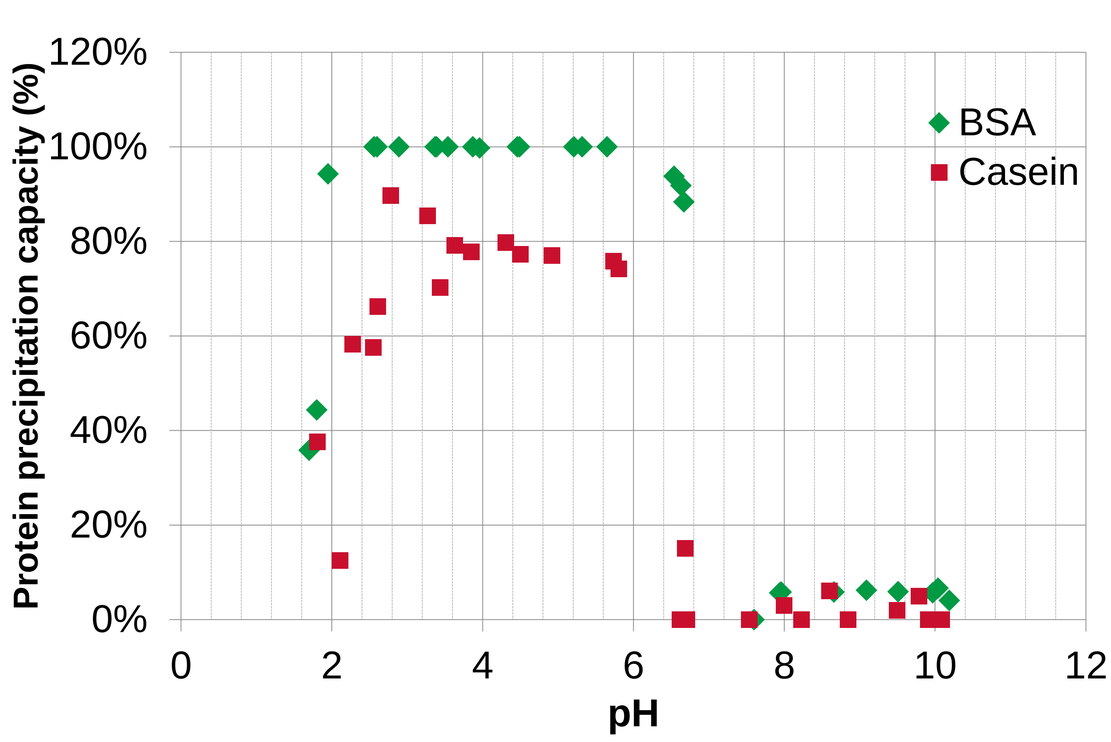

Figure 1 PPC of oak tannins with animal proteins

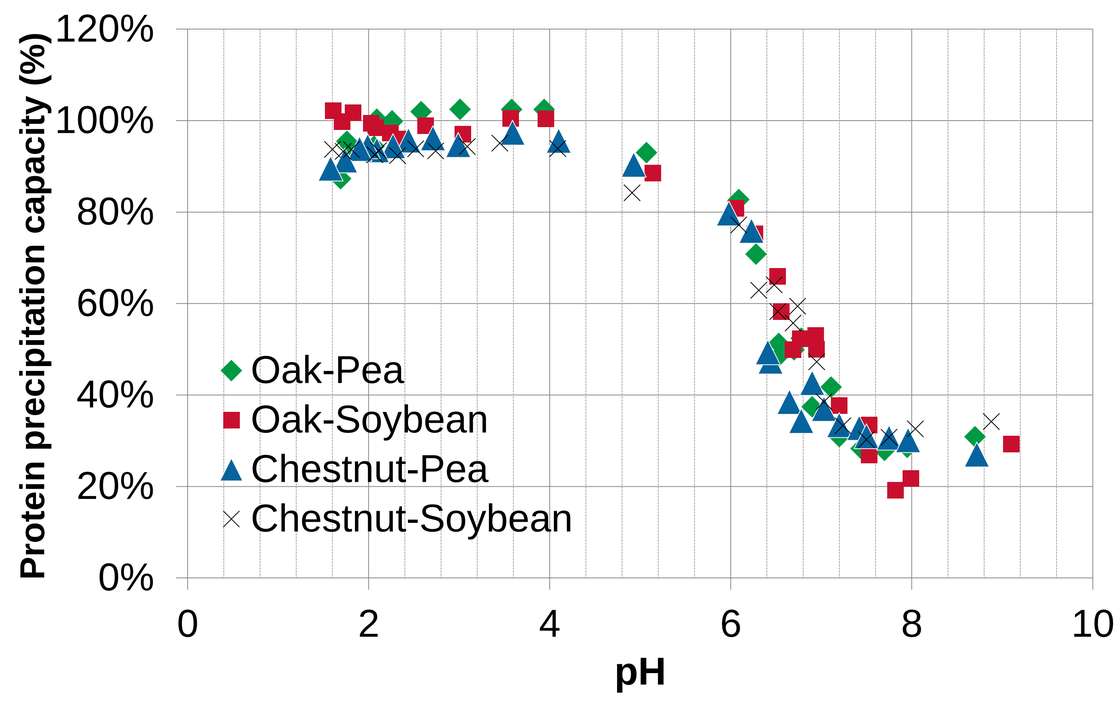

Figure 2 PPC of oak or chestnut tannins with plant proteins

Conclusion

In the rumen environment, tannins and protein complexation can occur. Complexation will be lower at higher ruminal pH (7), often observed in forage based diets. In contradiction to literature, we showed that dissociation in the abomasum (pH 2-2.5) seems unlikely in presence of plant proteins.

References

Amory AM and Schubert CL ,1987. Oecologia 73, 420-424.
Jones WT and Mangan JL, 1977. Journal of The Science of Food and Agriculture 28, 126–136.
Piluzza G, Sulas L, Bullitta S, 2014. Grass and Forage Science 69, 32–48.

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