Tropical grain legumes as alternatives to soybean meal for small producers of monogastric animals in the tropics

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Conclusions

Differences in *in vitro* protein and starch hydrolysis as well as in nutritional composition suggest that white cowpea (WVU) is an interesting alternative to soybean meal, since it could be produced locally by smallholder farmers in the tropics, including more marginal environments affected by drought and low soil fertility. Utilization of grain legumes such as [lablab (LP), red cowpea (RVU) and canavalia (CB)] by monogastrics in raw form is constrained by antinutritional factors. Therefore, the effect of heat treatment to increase *in vitro* digestibility and reduce antinutritional factors should be investigated. *In vivo* trials are required to validate *in vitro* results and to assess the effect of other grain components (e.g. lectins) on the animals.

Objective

The objective of this work was to study the nutritional composition and *in vitro* hydrolysis of tropical grain legumes as possible protein alternatives to soybean for monogastric animals (pigs and poultry) for small producers in the tropics.

Materials and methods

Legumes material

Seeds from *Canavalia brasiliensis* (CB), *Lablab purpureus* (LP), *Vigna unguiculata* (white WVU, pink PVU, red RVU) were compared to extruded full-fat soybean (SB) *Glycine max*.

Nutritional composition

The nutritional composition of the studied grain legumes including trypsin inhibitor activity (TIA) was determined (Table 1).

Enzymatic hydrolysis

Grain legumes were incubated in adequate buffers at 39 °C. Porcine pepsin was added for 120 min followed with pancreatin for 240 min. Aliquots of incubation media were taken before (0 min), at the final pepsin (120 min) and pepsin-pancreatin (360 min) hydrolysis steps for determining the kinetics of *in vitro* protein hydrolysis. The degree of hydrolysis (DH_{CP}) was calculated based on N soluble in trichloracetic acid 7.5 % as a percentage of total N.

$$DH_{CP}\ (\%) = \text{soluble N} / \text{total N} * 100$$

Aliquots were also taken at 360 min to determine the degree of hydrolysis of starch (DH_S). The DH_S was calculated based in the amount of starch in the indigestive sample as a percentage of total starch using the follows equation:

$$DH_S\ (\%) = \text{indigestible starch} / \text{total starch} * 100$$

Results and discussion

Table 1. Nutritional composition of soybean and different tropical grain legumes.

Grain legume	CB	LP	PVU	RVU	WVU	SB
Composition (g/Kg DM)						
Dry matter (g/kg)	898	897	895	878	906	939
Crude protein	291	235	212	216	208	367
Ether extract	17	55	15	15	18	263
Ash	30	39	38	38	39	48
Starch	316	403	537	482	563	-
NDF	275	234	210	260	143	117
ADF	174	131	52	75	22	68
Gross energy (MJ/kg DM)	15.9	17.8	16.0	15.7	16.5	19.9
TIA (TUI/g protein/g DM)	4.1	6.1	4.5	4.8	5.0	2.6

- **Crude protein is higher in CB and SB as compared to the other grain legumes.**
- **The cowpeas presented a high starch concentration.**

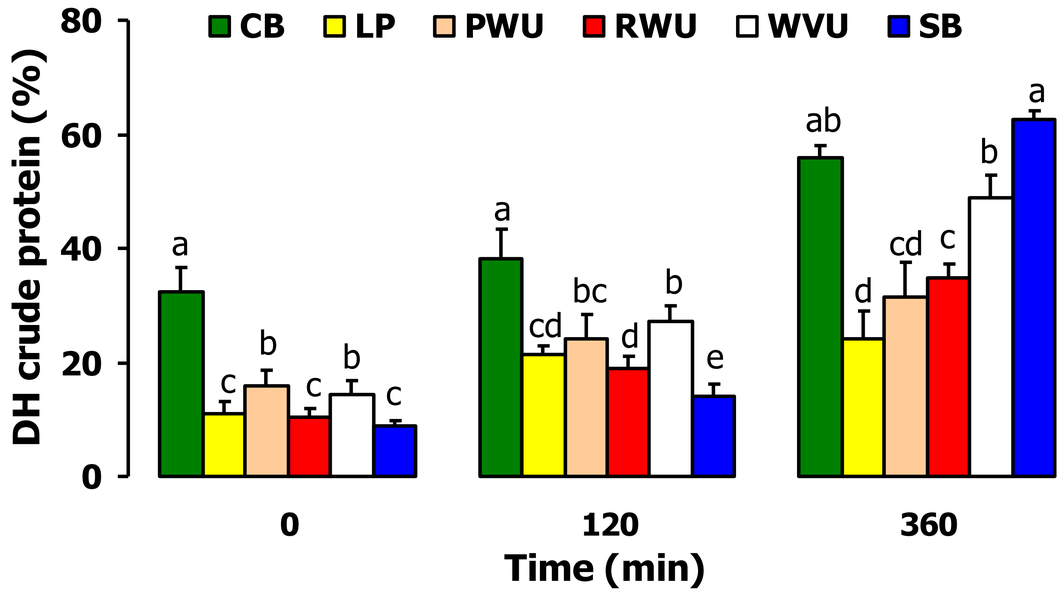

Figure 1. Degree of protein hydrolysis of soybean and tropical grain legumes at 120 min (pepsin) and 360 min (120 min pepsin + 240 min pancreatin) of *in vitro* hydrolysis.

- **At time 0 min of hydrolysis CB presented the highest amount of soluble N.**
- **Differences ($P<0.001$) in DH_{CP} were observed at 120 min of hydrolysis, SB presented the lowest pepsin hydrolysis (Figure 1).**
- **At 360 min of hydrolysis SB, CB and WVU presented the highest ($P<0.001$) DH_{CP}. The high DH_{CP} of CB was influenced by its high amount of soluble N at time 0 min.**
- **At 360 min DH_{CP} was negatively correlated with TIA ($R^2=0.64$, $P<0.05$). Although LP was well hydrolysed by pepsin the high content of TIA did not permit a better hydrolysis by pancreatin.**

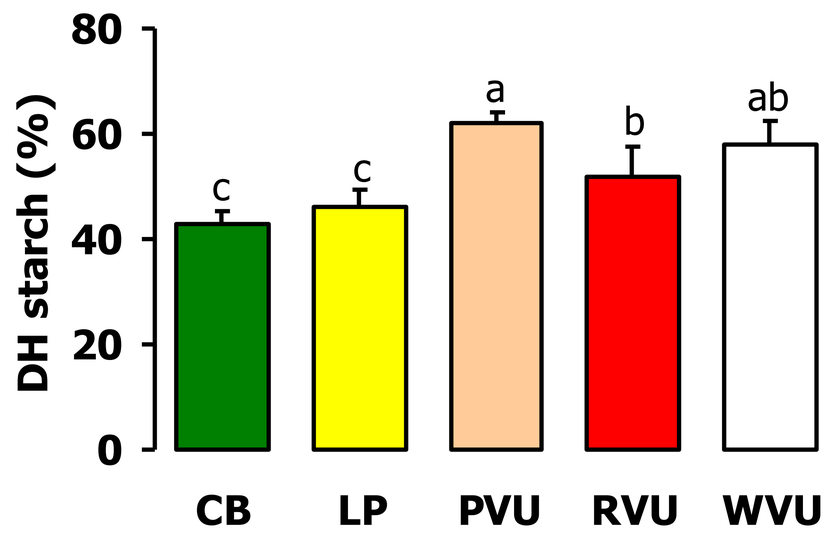

Figure 2. Degree of starch hydrolysis of tropical grain legumes at 360 min (120 min pepsin + 240 min pancreatin) of *in vitro* hydrolysis.

- **The DH_S was higher ($P<0.001$) for cowpeas as compared to the other tropical grain legumes (Figure 2).**
- **DH_S was negatively correlated with NDF content ($R^2=0.72$, $P<0.01$).**

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