

# Intake, digestion and duodenal nitrogen flow in sheep fed tropical diets supplemented with fruits of *Sapindus saponaria*

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## Livestock are central to the livelihood of the rural poor in developing countries (Delgado et al., 1999)

- important source of food and cash income
- enable farmers to diversify incomes, to reduce income variability and to minimise risks of natural disasters
- one of the few assets available to the poor, especially poor women
- manure and draft power are vital for soil fertility and sustainability of mixed farming systems
- allow the poor to exploit common property resources



## The Livestock Revolution (Delgado et al., 1999)

- dramatic increase in the demand for food products of animal origin
- in the developing world, livestock production increased by over 5% annually from 1983 to 1993
- in these regions, demand for beef and milk is projected to double in the next 20 years

➤ Livestock production offers one of the few rapidly growing markets that poor, rural people can join



**However...**

**the most important constraints that smallholders currently face are poor quality and often deficient availability of fodder**

- **low in protein and certain essential minerals**
  - **high in fibre**
  - **low in non-structural carbohydrates**
- 
- **low microbial activity and deficient microbial protein synthesis in the rumen**
  - **low availability of metabolizable nutrients**
  - **low levels of animal production**



## Alternatives to improve animal productivity

### Legume shrubs and trees



**Grass-legume associations**



**Saponin-containing feeds**



## Complete and partial defaunation

(i.e. the removal of rumen protozoa)

- increased the flow of microbial and dietary N
- improved the utilization of N

## Supplementation with *Sapindus saponaria*

- increased wool growth
- increased feed conversion and liveweight gain
- suppressed rumen protozoa populations

## However...

...little information is available on the effects of *S. saponaria* on protein digestion and duodenal N flow

...it is unknown whether the effects of *S. saponaria* are dependent on the quality of the basal diet

## Therefore...

...an experiment was carried out to study the effects of *S. saponaria* on intake, digestion and N utilization of sheep fed tropical grass-alone and grass-legume diets



## *Brachiaria dictyoneura*

**3.7% Crude Protein**

**72.8% NDF**

**41.1% ADF**



## *Cratylia argentea*

**18.6% Crude Protein**

**60.2% NDF**

**36.5% ADF**

**6.7% Condensed Tannins**



## *Sapindus saponaria*

**8.5% Crude Protein**

**38.0% NDF**

**23.0% ADF**

**12.0% Saponins**

**21.0% Total Sugars**



## Experimental design

- **Six African-type sheep fitted with ruminal and duodenal cannulae**
- **Allotted to four treatments in an incomplete repeated Latin-square design with 2x2 factorial arrangement**
- **2 basal diets (grass-alone and grass-legume), animals were offered daily 80 g DM/kg BW<sup>0.75</sup> (0 and 25% legume)**
- **2 levels of *S. saponaria* (0 and 8 g/kg BW<sup>0.75</sup>)**
- **4 experimental periods of 17 days each, 7 days served for adjustment and 10 days for measurement**

## Intake and digestibility

	Grass-alone		Grass-legume		S.E.	Significance		
	Control	+ Sap.	Control	+ Sap.		Leg.	Sap.	LxS
Total intake	g/day							
DM	692	774	834	918	46.9	**	n.s.	n.s.
NDF	515	545	575	626	36.8	+	n.s.	n.s.
ADF	282	310	341	362	21.3	*	n.s.	n.s.
Digestibility	%							
DM	51.4a	47.6b	47.6b	49.4ab	1.12	n.s.	n.s.	*
NDF	58.0a	51.0b	51.8b	53.7ab	1.98	n.s.	n.s.	*
ADF	49.6a	42.4b	42.3b	40.2b	1.38	**	**	+

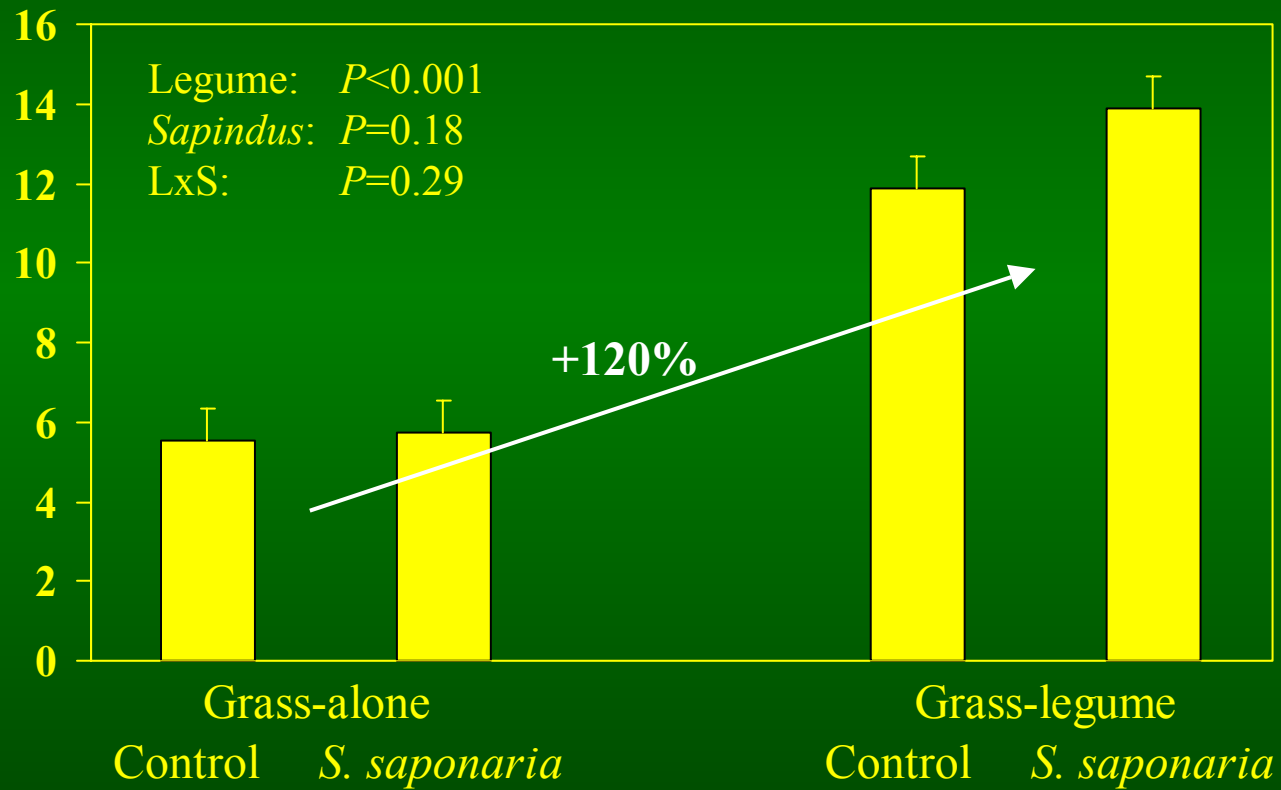
n.s., not significant; +, P<0.1; \*, P<0.05; \*\*, P<0.01; \*\*\*, P<0.001

## Ciliate protozoa counts in the rumen fluid

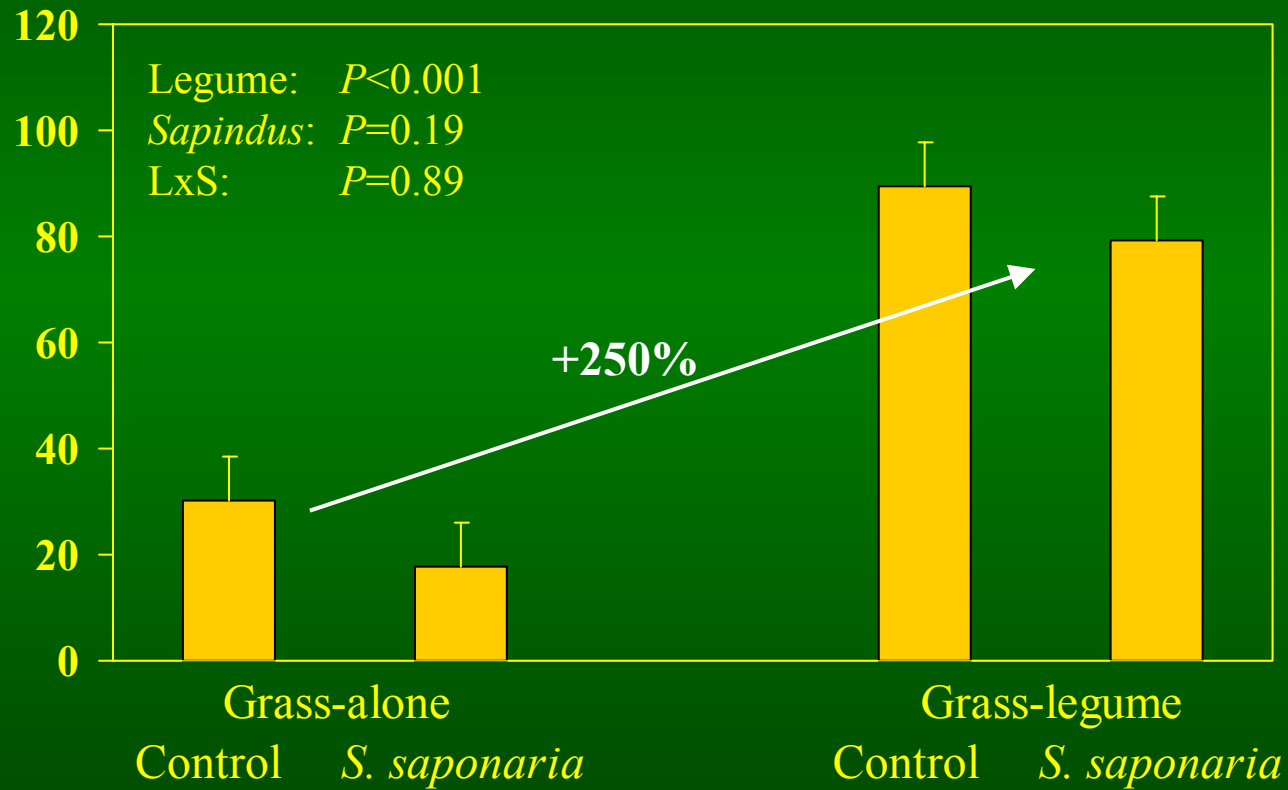
	Grass-alone		Grass-legume		S.E.	Significance		
	Control	+ Sap.	Control	+ Sap.		Leg.	Sap.	LxS
	10 <sup>4</sup> /ml							
Holotrichs	1.6	2.0	1.6	1.3	0.33	n.s.	n.s.	n.s.
Entodinium	8.5	17.1	9.1	14.3	1.58	n.s.	***	n.s.
Total	10.4	19.2	10.7	15.6	1.80	n.s.	**	n.s.

n.s., not significant; \*, P<0.05; \*\*, P<0.01; \*\*\*, P<0.001

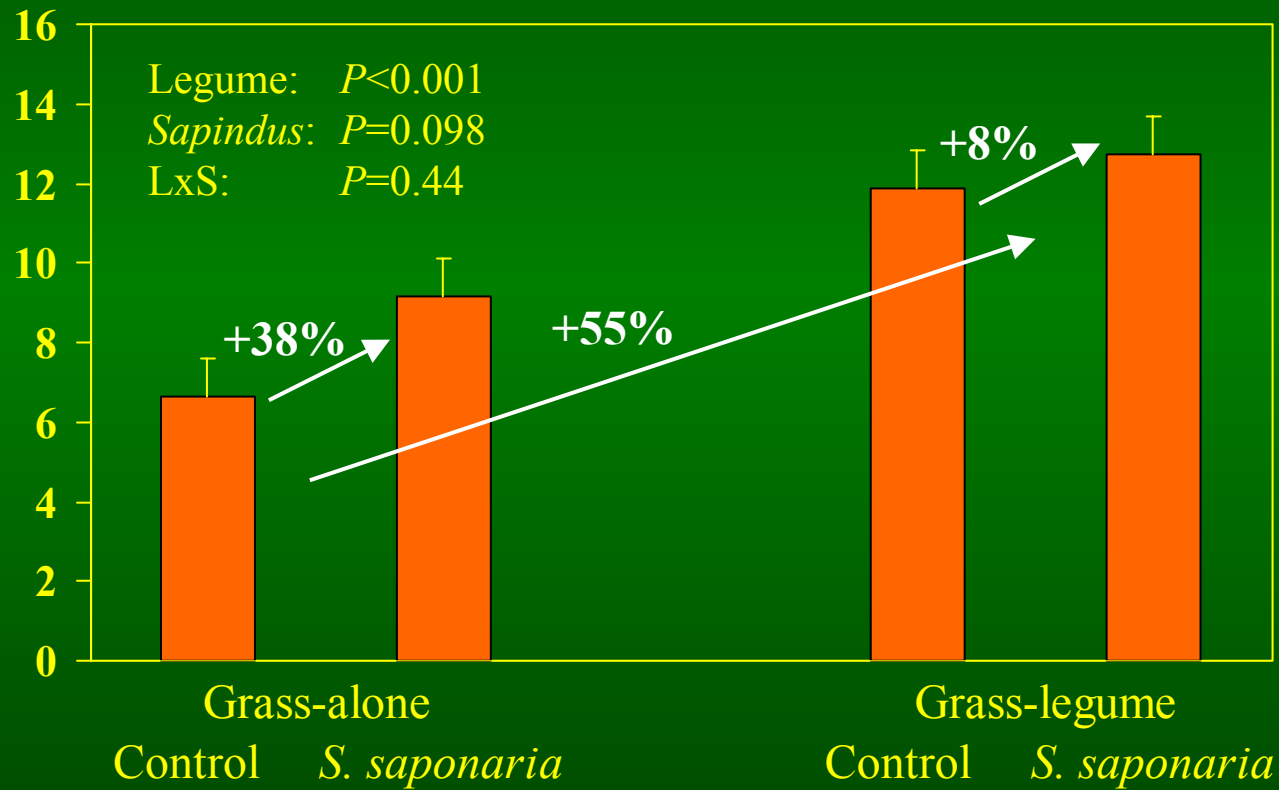
## Nitrogen intake (g/d)



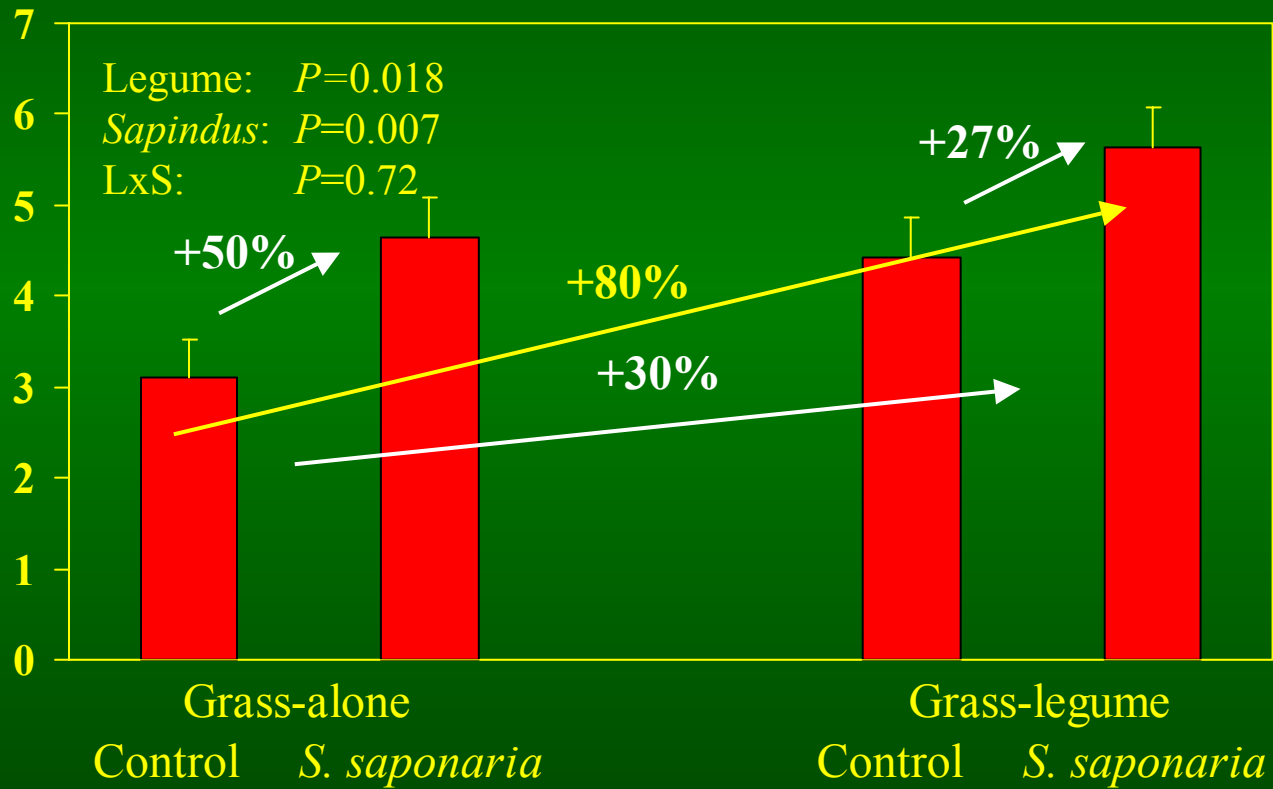
## Rumen ammonia N (mg/l)



## Total duodenal N flow (g/d)



## Microbial N flow (g/d)



## Volatile fatty acid concentration in rumen fluid

	Grass-alone		Grass-legume		S.E.	Significance		
	Control	+ Sap.	Control	+ Sap.		Leg.	Sap.	LxS
	mmol/l							
Total VFA	104	121	117	125	6.0	n.s.	*	n.s.
Acetated	82	92	90	93	4.6	n.s.	n.s.	n.s.
Propionate	15	20	18	22	1.2	*	**	n.s.
Butyrate	7	10	7	10	0.6	n.s.	***	n.s.
Iso-butyrate	0.4	0.3	0.7	0.5	0.05	***	**	n.s.
	mmol/mmol							
A:P	5.6	4.8	5.0	4.2	0.17	**	***	n.s.

n.s., not significant; \*, P<0.05; \*\*, P<0.01; \*\*\*, P<0.001



- ➔ The supplementation with *Cratylia argentea* increased voluntary forage intake by 20% and N intake by 120%
- ➔ *Sapindus saponaria* had no effect on forage intake and reduced DM and NDF digestibility in the grass-alone diet but not in the grass-legume diet
- ➔ Protozoa counts were not affected by the legume and were increased by *Sapindus saponaria*
- ➔ *Cratylia argentea* increased the flows of total N (+55%) and of microbial N (+30%)
- ➔ *S. saponaria* increased the flow of microbial N (+36%)
- ➔ *C. argentea* and *S. saponaria* independently shifted VFA production towards lower acetate:propionate proportions

**These results indicate that...**

- ... the protozoa suppressing effect of *Sapindus saponaria* is not always apparent**
- ... the flow of microbial nitrogen to the duodenum is increased by *Sapindus saponaria*, independent of the quality of the basal diet**
- ... *Sapindus saponaria* increases the efficiency of rumen fermentation**
- ... the positive effects of *Cratylia argentea* and *Sapindus saponaria* on rumen fermentation are additive and interactions are mostly not significant**

**Thank you!**

