Urea treated cocoa pod as barley grain substitution in ruminant ration on microbial metabolism and feed degradation (Rusitec Study)

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COCOA POD TREATMENT
Previous Study
Simple chemical treatment as effective as biological
Urea 20 g/kg FS gave the highest digestibility
Too high
Need further study about toxicity in more physiological in vitro model such rusitec
Need adequate available energy
matched supply

Objective

- investigating the effects urea treated cocoa pod inclusion in ruminant ration as barley substitution on methane release, SCFA production, N-metabolism, synthesis microbial Protein, rate of disappearance of DM and nutrients.
- The toxicity effect of high dose urea application on rusitec fermentation

Methods

Treatments: 6 rations

- R1 : 10 g Hay
- R2 : R1 + 4 g barley
- R3 : R1 + 3 g barley + 1 g CPs
- R4 : R1 + 2 g barley + 2 g CPs
- R5 : R1 + 1 g barley + 3 g CPs
- R6 : R1 + 4 g CPs

Rusitec Procedure

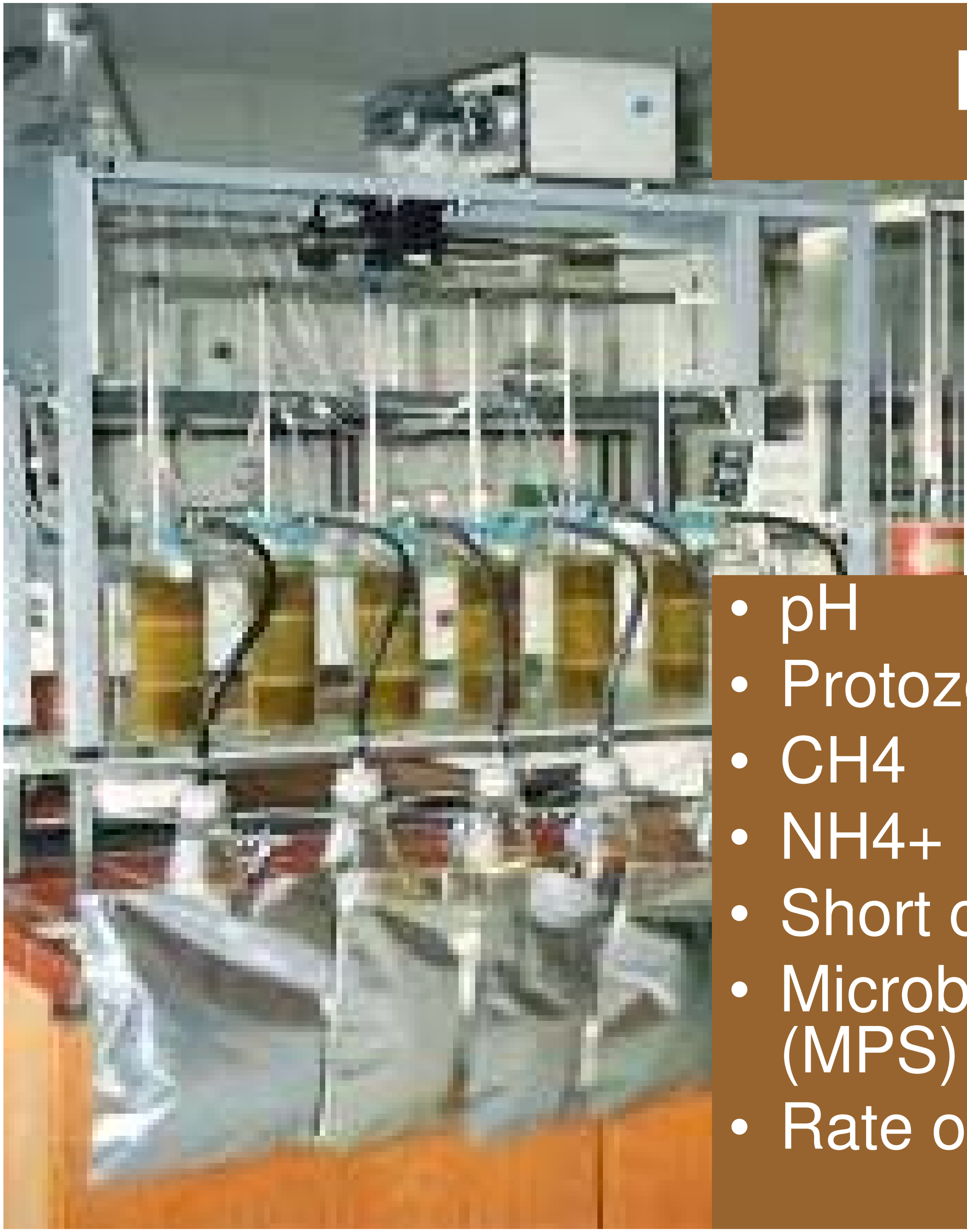
(Czerkawski & Breckenridge ,1977).

3 replications (runs)
6 fermenters for each run.
Each run lasted 14 days
- 9 days preliminary phase
- 5 days collecting phase.

Rusitec Procedure

(Czerkawski & Breckenridge ,1977).

- Water bath was set for 39 ^{o}C
- Fermenter Volume 1060 ml.
- 2 Nylon bag contained hay and concentrate introduced everyday with 48 h incubation time
- Ration stroke frequency = 400 time/h
- Rumen fluid as inoculum
- Buffer infusion rate 620 ml/d



Parameters

- pH
- Protozoal population
- CH_4
- NH_4^+
- Short chain fatty acid (SCFA)
- Microbial protein synthesis (MPS)
- Rate of disappearance

Results

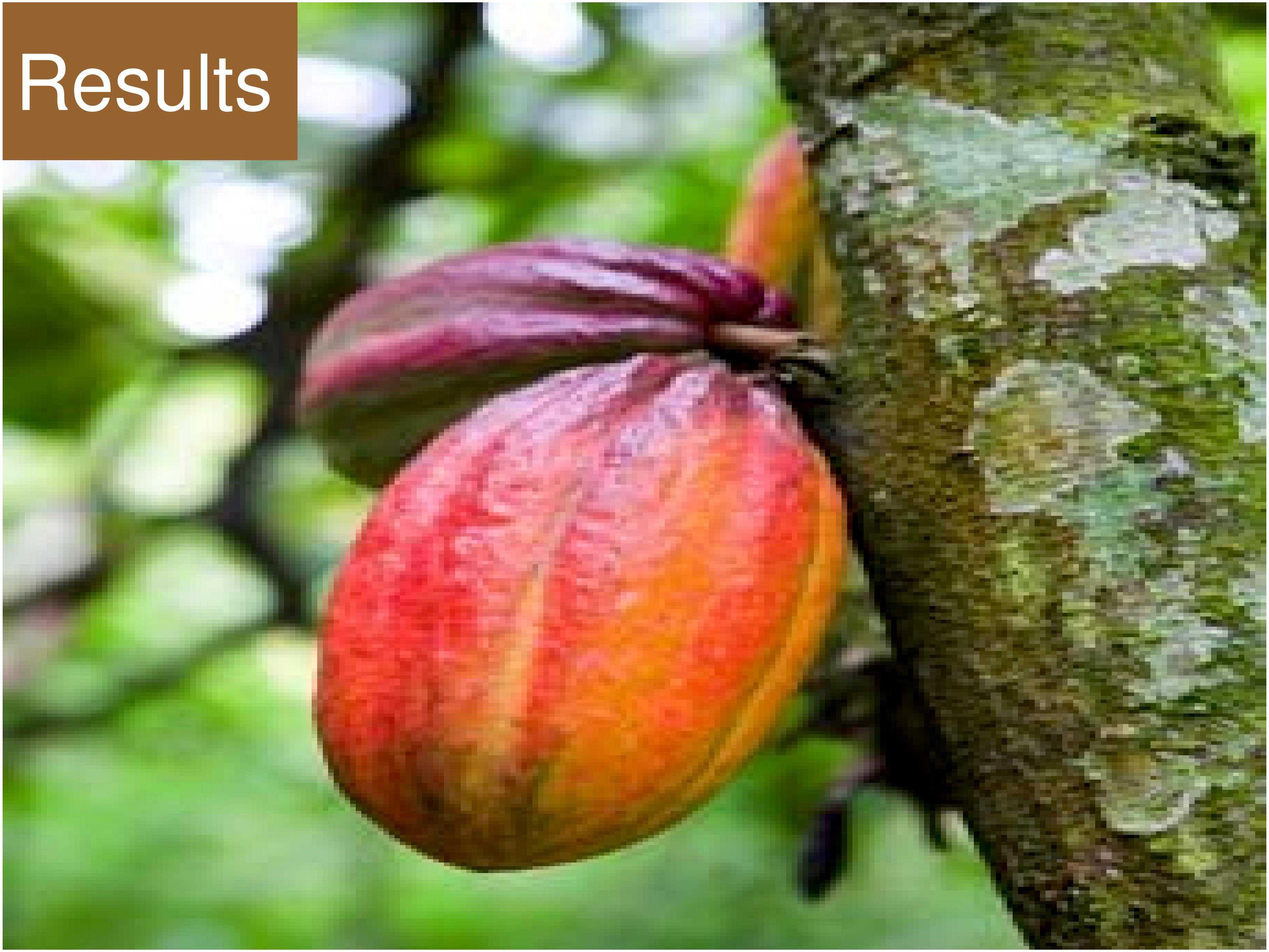


Table 3: Effect of replacing barleyby urea treated cocoa pod on fermentation characteristics in Rusitec

Parameter	Treatment					
	T1	T2	T3	T4	T5	T6
PH	6.63[d]	6.51[a]	6.52[ab]	6.54[b]	6.59[c]	6.63 [d]
Protozoa (cts/ml)	17475	17868	16310	14267	13672	12436
CH_4 (mmol/d)	5.45[a]	7.51[de]	7.71[e]	6.95[cd]	6.38[bc]	6.02[ab]
NH_4^+ (mmol/l)	5.64[a]	8.31[d]	7.42[c]	7.28[c]	6.68[b]	6.48[b]

Table 3: Effect of replacing barley/soybean meal-mixture by urea treated cocoa pod on fermentation characteristics in Rusitec

Parameter	Treatment					
	T1	T2	T3	T4	T5	T6
SCFA (mmol/d)	**24.88**^{a}	**35.61**^{b}	**33.59**^{b}	**31.94**^{ab}	**30.94**^{ab}	**28.78**^{ab}
acetate	14.46^{a}	18.84^{b}	18.47^{b}	17.85^{ab}	17.80^{ab}	17.26^{ab}
propionate	6.07^{a}	9.20^{b}	8.57^{b}	7.76^{ab}	7.52^{ab}	6.59^{a}
iso-butyrate	0.17	0.25	0.18	0.16	0.15	0.20
n-butyrate	3.02	5.14	4.58	4.45	3.94	3.41
iso-valerate	0.60^{a}	1.12^{d}	0.98^{cd}	0.88^{bc}	0.79^{abc}	0.70^{ab}
n-valerate	0.56	1.06	0.81	0.84	0.75	0.63
Microbial cells (mg DM/d)	**700**^{a}	**859**^{c}	**821**^{b}	**782**^{b}	**793**^{b}	**776**^{b}

Table 4: Disappearance of dry matter and nutrients of the feed ration in Rusitec (g/d)

Parameter	Treatment					
	T1	T2	T3	T4	T5	T6
DM	4.7^{a}	6.1^{b}	6.2^{b}	6.1^{b}	5.7^{b}	5.7^{b}
OM	4.2	5.5	5.5	5.4	5.0	5.0
CP	0.8^{a}	1.0^{b}	1.0^{b}	1.0^{b}	0.9^{b}	1.0^{b}
CF	1.2^{ab}	1.0^{a}	1.2^{ab}	1.2^{ab}	1.3^{ab}	1.5^{b}
ADF	1.2^{ab}	1.0^{a}	1.2^{ab}	1.2^{ab}	1.2^{ab}	1.4^{b}
NDF	1.9^{a}	2.1^{ab}	2.4^{ab}	2.4^{ab}	2.2^{ab}	2.5^{b}

Table 4: Disappearance of dry matter and nutrients of the feed ration in Rusitec (%)

Parameter	Treatment					
	T1	T2	T3	T4	T5	T6
DM	49.9^{b}	47.0^{ab}	47.4^{ab}	46.4^{ab}	46.2^{ab}	43.8^{a}
OM	49.0^{c}	46.1^{bc}	46.2^{bc}	45.1^{abc}	44.9^{ab}	41.6^{a}
CP	52.3^{b}	47.8^{a}	45.4^{a}	44.4^{a}	46.9^{a}	46.3^{a}
CF	41.4	33.4	34.9	31.4	32.1	32.0
ADF	38.0^{b}	29.8^{a}	30.4^{ab}	27.3^{a}	27.6^{a}	26.6^{a}
NDF	35.6	33.5	34.7	32.4	31.9	30.9

Table 6: Stoichiometry of fermentation in Rusitec

Parameter	Treatment					
	T1	T2	T3	T4	T5	T6
Microbial cell (MC) measured in Rusitec (mg/d)	**700**^{a}	**859**^{c}	**822**^{bc}	**783**^{b}	**793**^{b}	**776**^{b}
Microbial-N/OMAD (mg/g)	13.3^{b}	12.4^{ab}	11.9^{ab}	11.6^{a}	12.9^{ab}	12.5^{ab}
CH_4/OMAD (mmol/g)	1.29	1.37	1.40	1.29	1.28	1.23
CH_4/NDF disappearance (mmol/g)	2.86^{ab}	3.55^{c}	3.29^{bc}	2.97^{abc}	2.89^{ab}	2.42^{a}

Conclusions

- Urea treated cocoa pod cannot replace barley equivalently
  - Lower fermentation intensity (SCFA and Microbial)
- Can be used as a feedstuff for low performance ruminants without reducing the efficiency of microbial synthesis.
- No toxicity effects were observed with the inclusion of urea treated cocoa pod in the ration as to a dramatically disturbed fermentation or a too high concentration of ammonia.


Thank you