

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

Need adequate
available energy

Urea 20 g/kg FS gave the
highest digestibility

Too high

Need further study about
toxicity in more
physiological in vitro
model such rusitec

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 °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
- CH₄
- NH₄⁺
- Short chain fatty acid (SCFA)
- Microbial protein synthesis (MPS)
- Rate of disappearance

Results

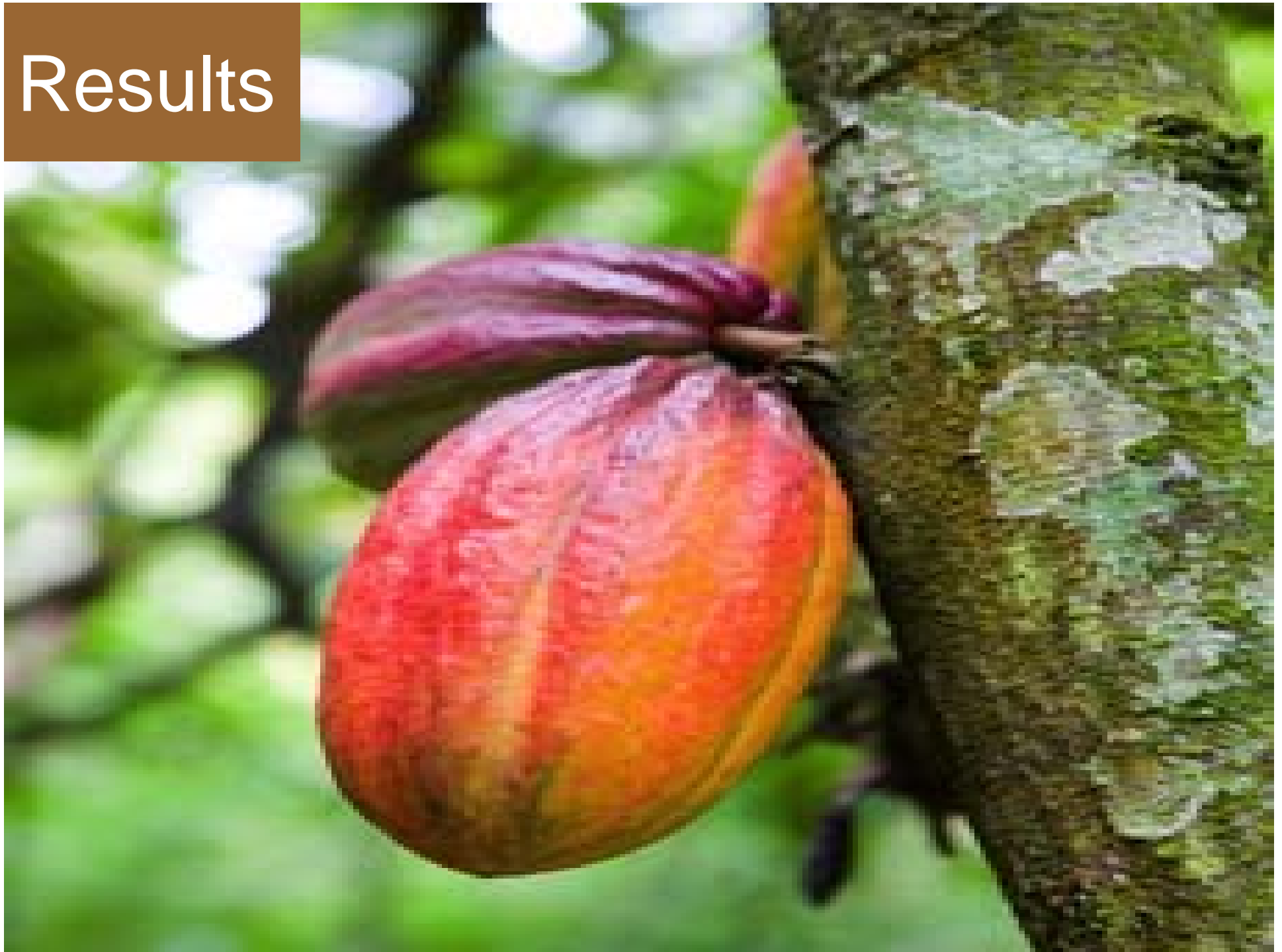


Table 3: Effect of replacing barley by urea treated cocoa pod on fermentation characteristics in Rusitec

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