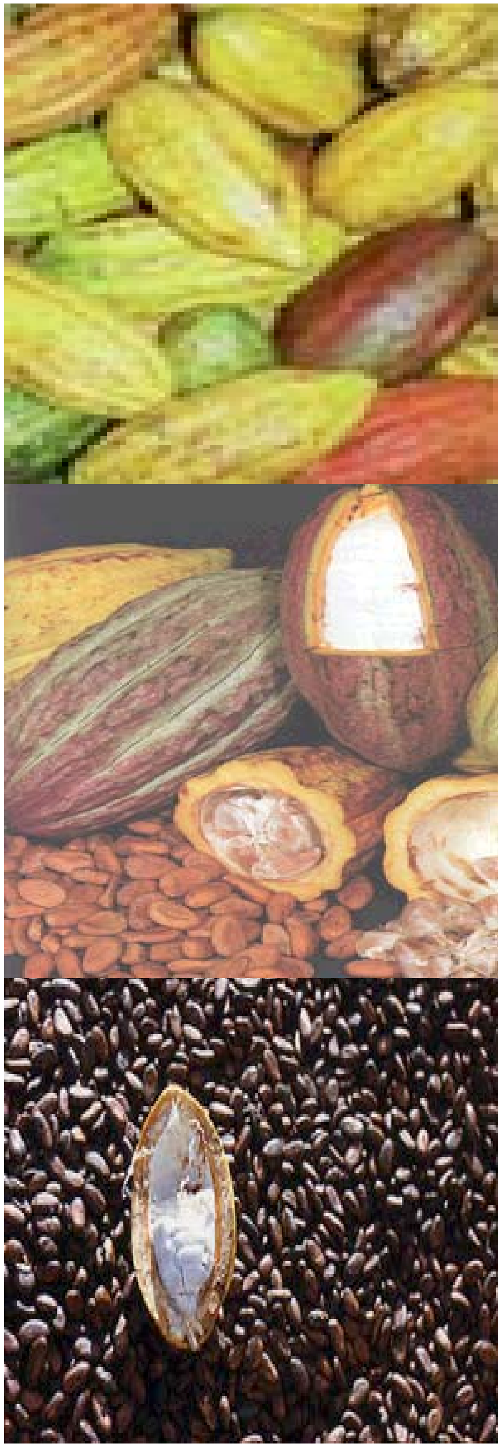

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IMPROVING COCOA POD QUALITY BY UREA, NaOH AND COCOA POD ASH ALKALI TREATMENTS FOR RUMINANT FEEDSTUFFS

Backgound

- Dev-ing countries:
  - Limiting of grain and high qualitiy fibre
  - abundant plantation by-product.
  - cocoa seed demand increase
  - release by-product; cocoa pods

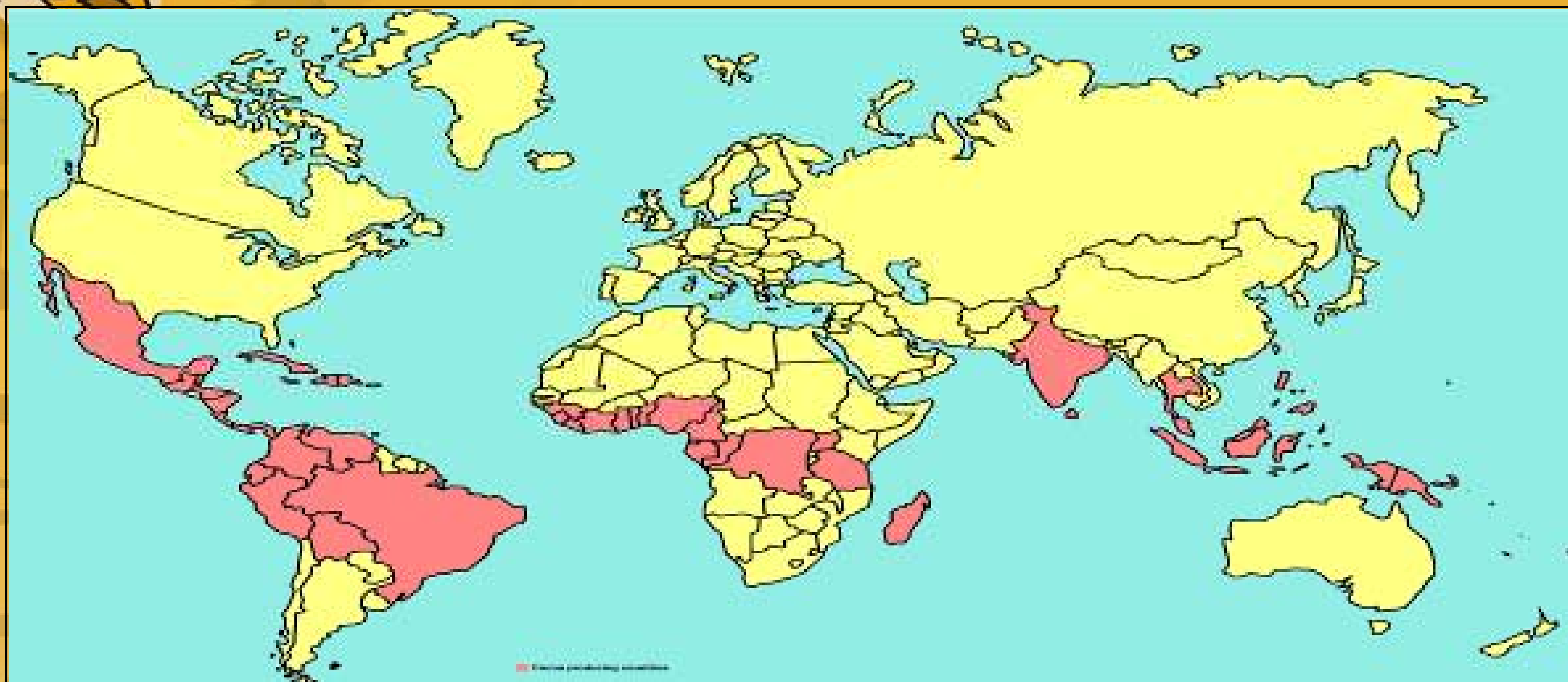


Figure 1.1: Cocoa producing countries (▫ producing country)
Source: ICCO (2001)

- Cocoa pods
  - late mature plant comp
  - high lignocellulosic
  - low utility
  - low animal performance
  - high excess to environment.

….. Need treatment to improve nutrient value

- Treatment to improve lignocellulosic
  - physic-, chemi- and biology-cally,
  - Laconi (2000): Simple chemical treatment using urea as effective as biological fermentation to improve cocoa pods quality.

Objectives

- To study the effect of alkali sources and their level on proximate composition, cell wall constituent and in vitro gas production
- To estimate digestibility and metabolisable energy of treated cocoa pod from gas production and proximate composition
- To found the best alkali source and its level which gave the maximum in vitro digestibility

METHODS

Treatments

Alkali sources	Level (g/kg cocoa pods		
Urea	10	20	30
NaOH	2	4	6
CPA	5	10	15

Control: Fresh and fermented cocoa pod without alkali

Fermentation & sample preparations

- Cocoa pod is cutted to 0.5 cm thick
- alkali agent is added (except control)
- homogenized
- incubated anaerobically for 2 weeks (except fresh control).
- The pods are then dried and milled to pass 0.5 mm screen.

Parameters

- Proximate compositions (Naumann and Bassler, 1976)
- Van Soest cell wall constituent (Van Soest, 1967)
- In vitro gas production (Menke et al., 1979)
- Estimate DOM and ME

In vitro gas production (Menke et al., 1979)

- Gas production (ml/200 mg DM)

- Estimate DOM

=14.88 + 0.889 Gb (ml) + 0.045 CP + 0.065 ASH

- Estimate ME

= 1.242 + 0.146 Gb (ml) + 0.007 CP + 0.224 XL

DOM (%), ME (MJ/kg DM); CP (g/kg DM);
ASH (g/kg DM); XL (g/kg DM)

Design

- Block design
- Factors: alkali source
- Level: 11
- Linear model:

$$Y_{ij} = \mu + \alpha_i + \beta_j + \varepsilon_{ij}$$

RESULTS AND DISCUSSION

Table 1: Proximate analysis of treated cocoa pod

Treats.	Dosis g/kg	DM %	ASH %	CP %	XL %	CF %
Fresh		87.65	7.88^{b}	9.34^{b}	0.54^{b}	52.30^{c}
Silage	0	89.44	6.19^{a}	8.68^{ab}	0.48^{ab}	42.09^{a}
CPA	5	87.41	8.34^{b}	7.85^{ab}	0.50^{ab}	49.59^{bc}
	10	87.09	9.32^{bc}	7.89^{ab}	0.63^{b}	50.83^{bc}
	15	86.67	10.39^{c}	7.96^{ab}	0.47^{ab}	49.32^{bc}
NaOH	2	88.88	7.89^{b}	7.49^{a}	0.43^{ab}	46.30^{ab}
	4	87.32	9.59^{c}	7.33^{a}	0.34^{ab}	46.27^{ab}
	6	87.16	10.64^{c}	7.33^{a}	0.27^{a}	47.67^{bc}
Urea	10	88.88	6.32^{ab}	19.36^{c}	0.40^{ab}	47.18^{bc}
	20	88.06	5.81^{a}	26.51^{d}	0.39^{ab}	49.98^{bc}
	30	87.96	5.49^{a}	43.24^{e}	0.48^{ab}	46.83^{b}

CPA = Cocoa pod ash. The cocoa pod was incubated anaerobically for 2 weeks except for fresh treatment.
Different superscript at the same column shows the statistically different at $p < 0.05$

Table 2. Van Soest analysis of treated cocoa pod

Treatments	Dosis	ADF	NDF
	g/kg	%	%
Fresh		69.52^{b}	79.48^{ab}
Silage	0	62.15^{ab}	82.04^{ab}
CPA	5	69.23^{b}	86.81^{b}
	10	67.21^{b}	84.82^{b}
	15	66.60^{b}	80.73^{ab}
NaOH	2	64.60^{b}	85.38^{b}
	4	67.10^{b}	80.13^{ab}
	6	62.67^{ab}	76.70^{a}
Urea	10	61.39^{ab}	82.59^{ab}
	20	62.13^{ab}	81.92^{ab}
	30	58.61^{a}	80.07^{ab}

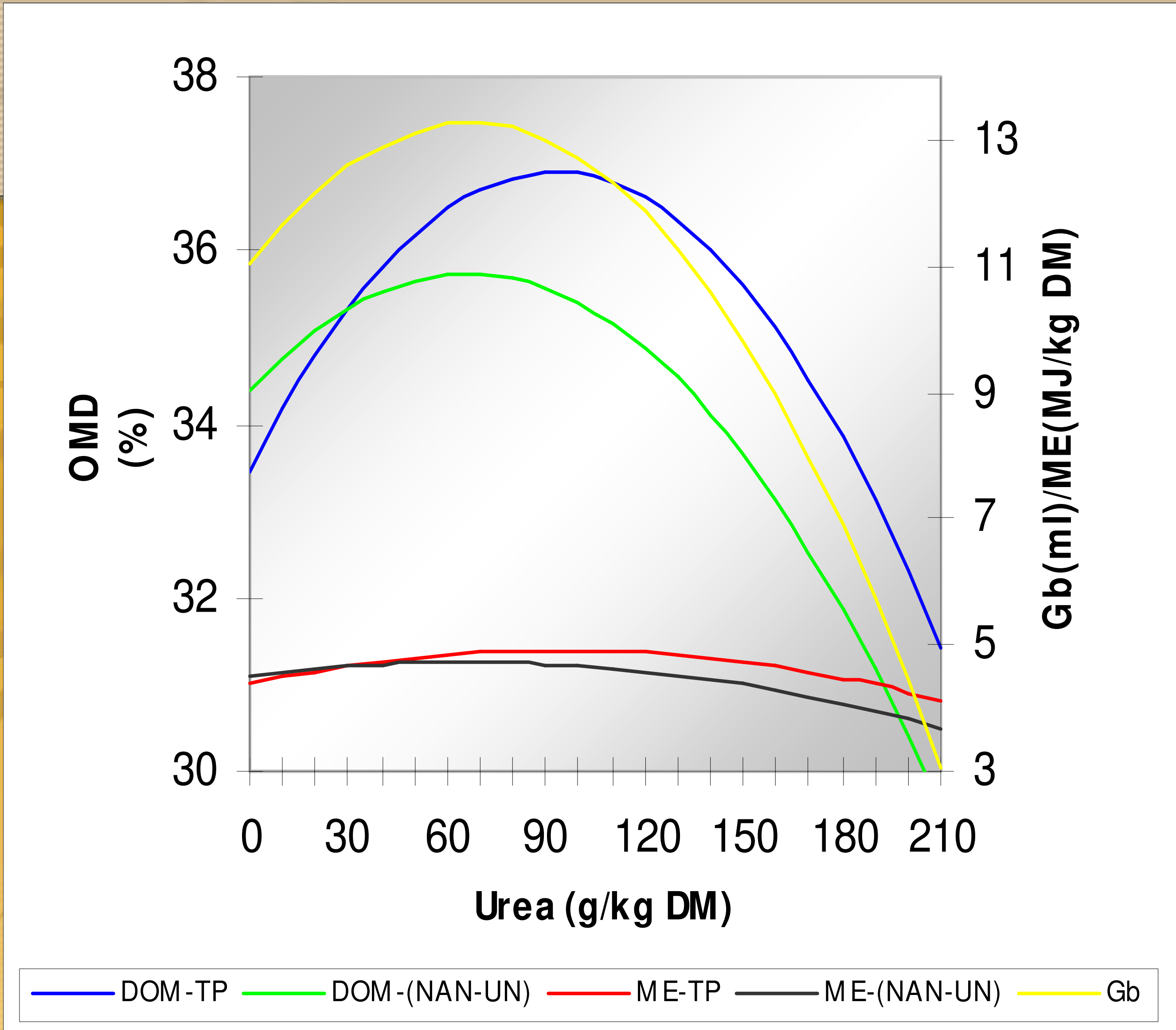
CPA = Cocoa pod ash. The cocoa pod was incubated anaerobically for 2 weeks except for fresh treatment.
Different superscript at the same column shows the statistically different at $p < 0.05$

Table 3. Gas production, estimated of digestibility and ME

Treat.	Dosis g/kg	Gb ml/200 mg DM	OMD %	ME MJ/kg DM
Fresh		9.41^{c}	32.61^{ab}	3.40^{b}
Silage	0	11.51^{d}	33.04^{ab}	3.64^{b}
CPA	5	8.85^{bc}	31.70^{ab}	3.20^{ab}
	10	8.17^{b}	31.75^{ab}	3.13^{ab}
	15	9.28^{bc}	33.47^{b}	3.26^{ab}
NaOH	2	9.68^{c}	31.98^{ab}	3.28^{b}
	4	8.05^{b}	31.57^{a}	3.01^{a}
	6	9.08b^{c}	33.17^{ab}	3.14^{ab}
Urea	10	12.07^{d}	38.43^{c}	4.45^{c}
	20	12.99^{d}	42.13^{d}	5.08^{d}
	30	4.86^{a}	42.07^{d}	5.06^{d}

Response of OMD and ME on urea applications

No	Formula	Peak	n	r^2	F
	Based on Gb	g/kg DM			
1	$Gb = 11.0306 + 0.067U – 0.0005U^2$	67	12	0.86	0.000
	Based on %TP (TP-N x 6.25)				
2	$OMD = 33.4659 + 0.0743\ U - 0.0004\ U^2$	93	12	0.84	0.000
3	$ME = 4.3889 + 0.0113\ U - 0.00006\ U^2$	94	12	0.84	0.000
	Based on (NAN – UR-N) x 6.25				
4	$OMD = 34.3873 + 0.0401\ U - 0.0003\ U^2$	67	12	0.75	0.000
5	$ME = 4.5191 + 0.0065\ U - 0.00005\ U^2$	65	12	0.72	0.000



OMD (%)
38
36
34
32
30
13
11
9
7
5
3
Gb(ml)/ME(MJ/kg DM)
0
30
60
90
120
150
180
210
Urea (g/kg DM)
DOM-TP
DOM-(NAN-UN)
ME-TP
ME-(NAN-UN)
Gb

Conclusion

- Urea is the most suitable alkali source for cocoa pod quality improvement
- On local absence of the alkali source, the improvement quality of cocoa pod with silage treatment is also recommended
- The (NAN-UR) value is suggested to be the nearest evaluation of the real protein value of urea treated cocoa pods.
- The optimum level of urea was 67 g/kg DM cocoa pods.