United Nations Nations Unies

International Seminar and Exhibition on Animal Feed Biotechnology

Microbiological Technology in Feed industry (Ruminants)

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Microbiological Technology

- Silage inoculants
- Forage upgrading in the rumen
- Probiotics (or Synbiotics)

1 Silage inoculants

Silage with poor nutritional value

Decrease

milk yield, weight gain and health

Alfalfa silage for 120 days

*（王加启和刘辉，**2003**）*

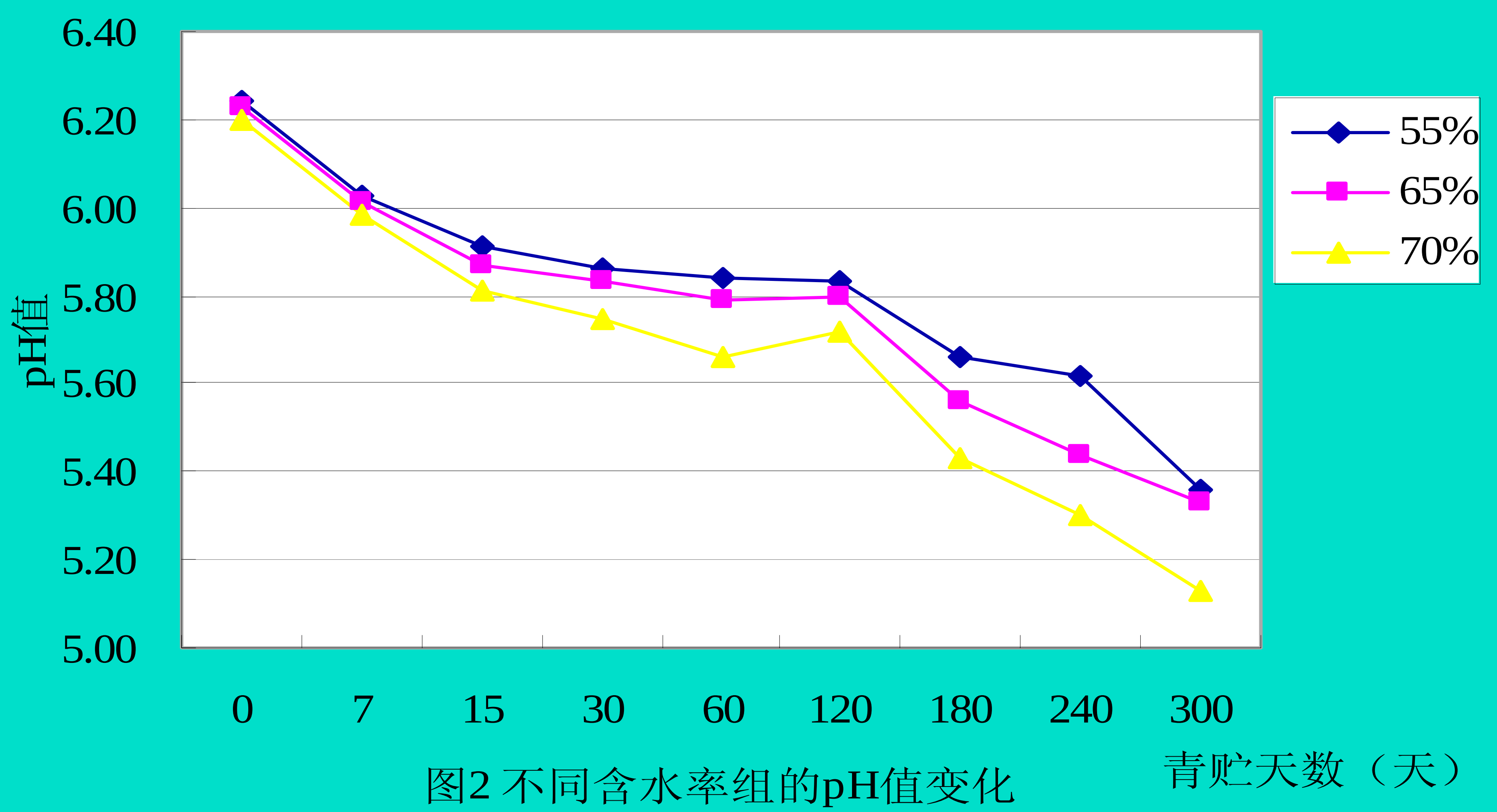


图2 不同含水率组的pH值变化

pH Reduction of Alfalfa Silage *（王加启和刘辉，2003）*

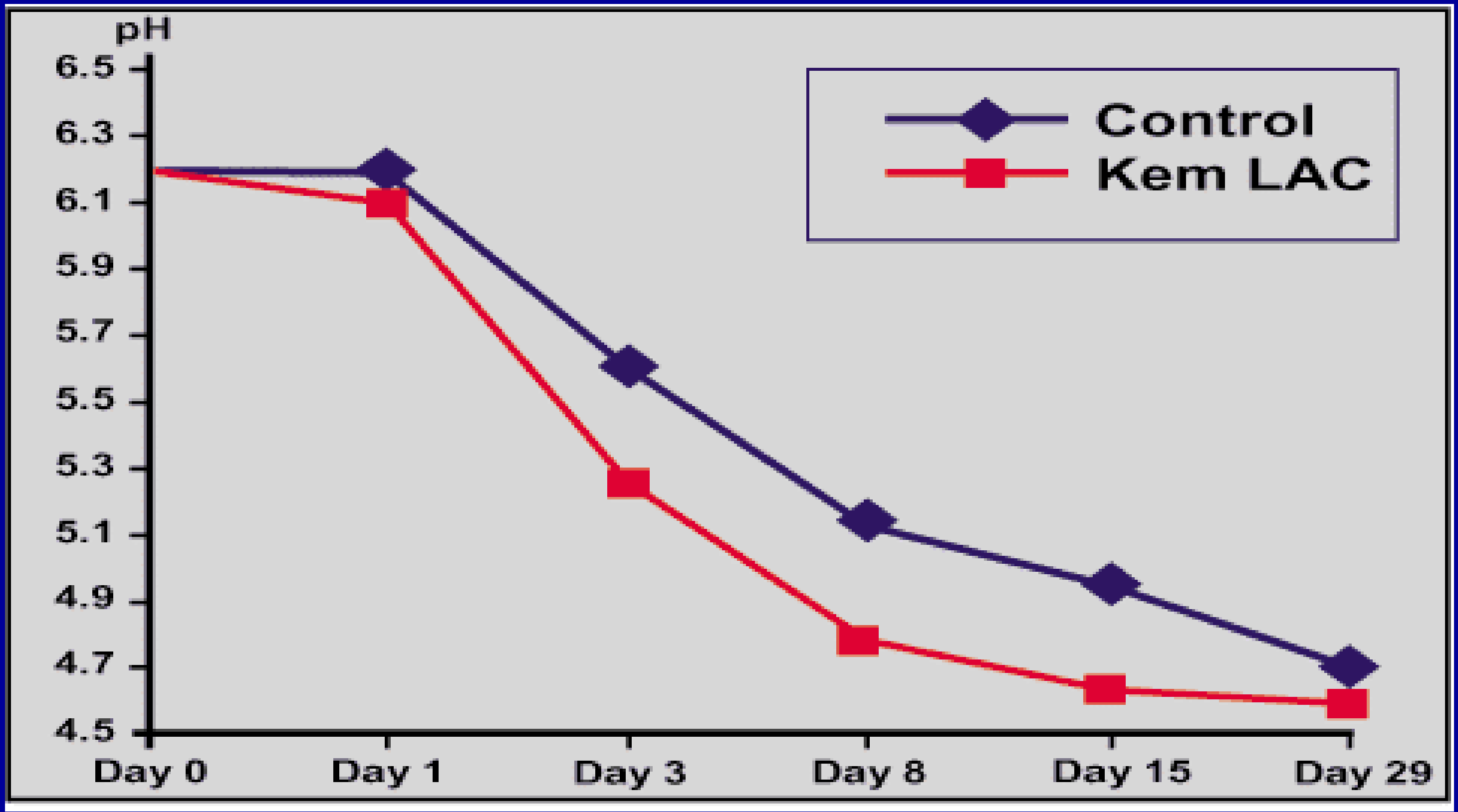
1 Silage inoculants

lactic acid bacterium (LAB)

↓

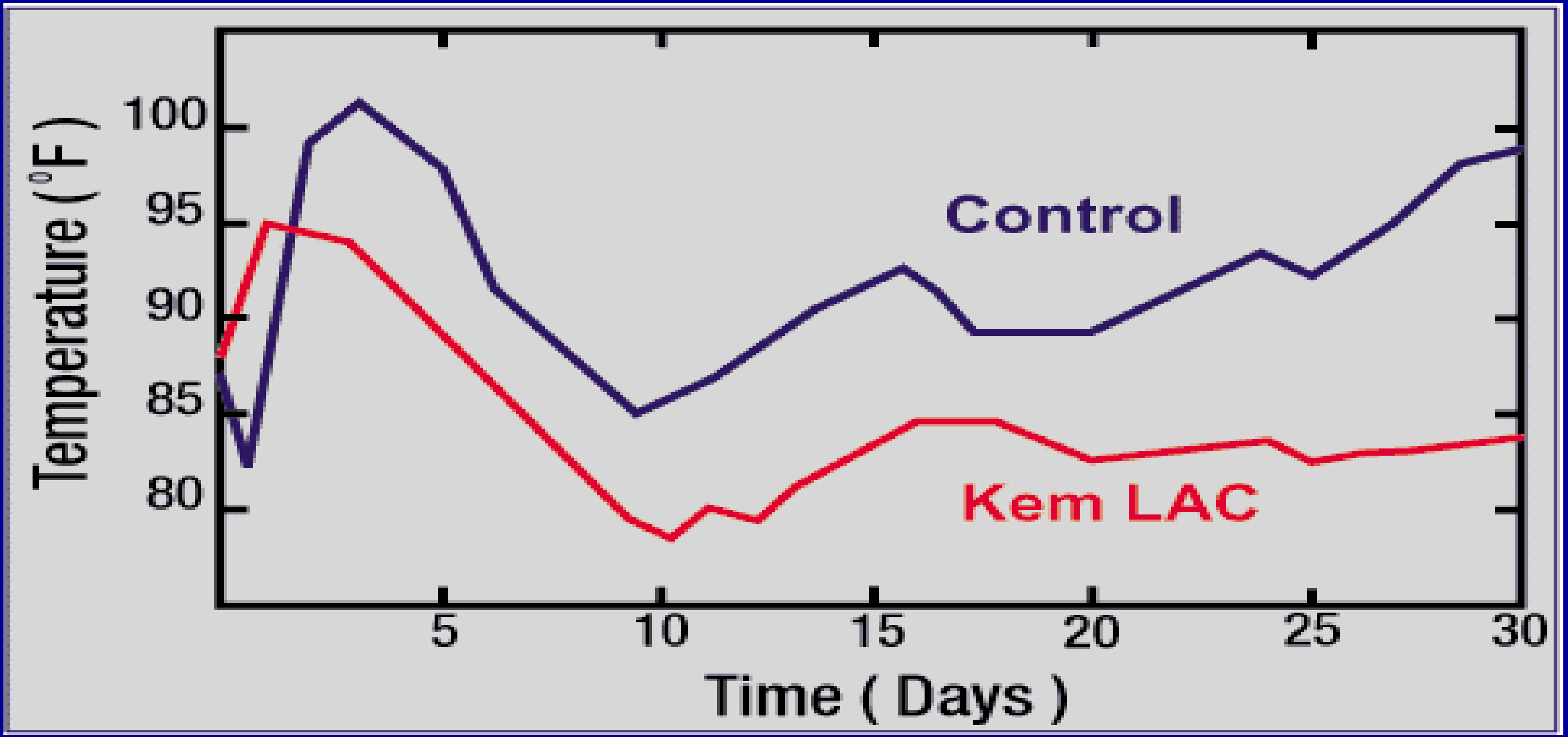
- **metabolic activity is reduced**
- **undesirable compounds is restricted**
- **hazardous organisms is inhibited**

1 Silage inoculants



Effect of LAB on pH Reduction of Alfalfa Silage

1 Silage inoculants



Effect of LAB on Heating in Alfalfa Silage

1 Silage inoculants

Three crucial factors :

- The natural abilities of the bacteria involved
- The number of bacteria applied
- The stability of the inoculant when used on the farm

Important Viable Counting

	DFM1		DFM2	
	Total	Viable	Total	Viable
1	3.70×10^{1}	1.51×10^{7}	2.87×10^{13}	1.11×10^{8}
2	3.69×10^{13}	5.18×10^{7}	3.06×10^{13}	1.48×10^{8}
3	3.51×10^{13}	4.11×10^{7}	2.33×10^{13}	1.59×10^{8}
Average	3.60×10^{13}	3.60×10^{7}	2.76×10^{13}	1.39×10^{8}

*周凌云和王加启，**2003***

2 Forage upgrading in the rumen

Effect of tannins

on rumen microbial ecology

Acacia angustissima(金合欢）

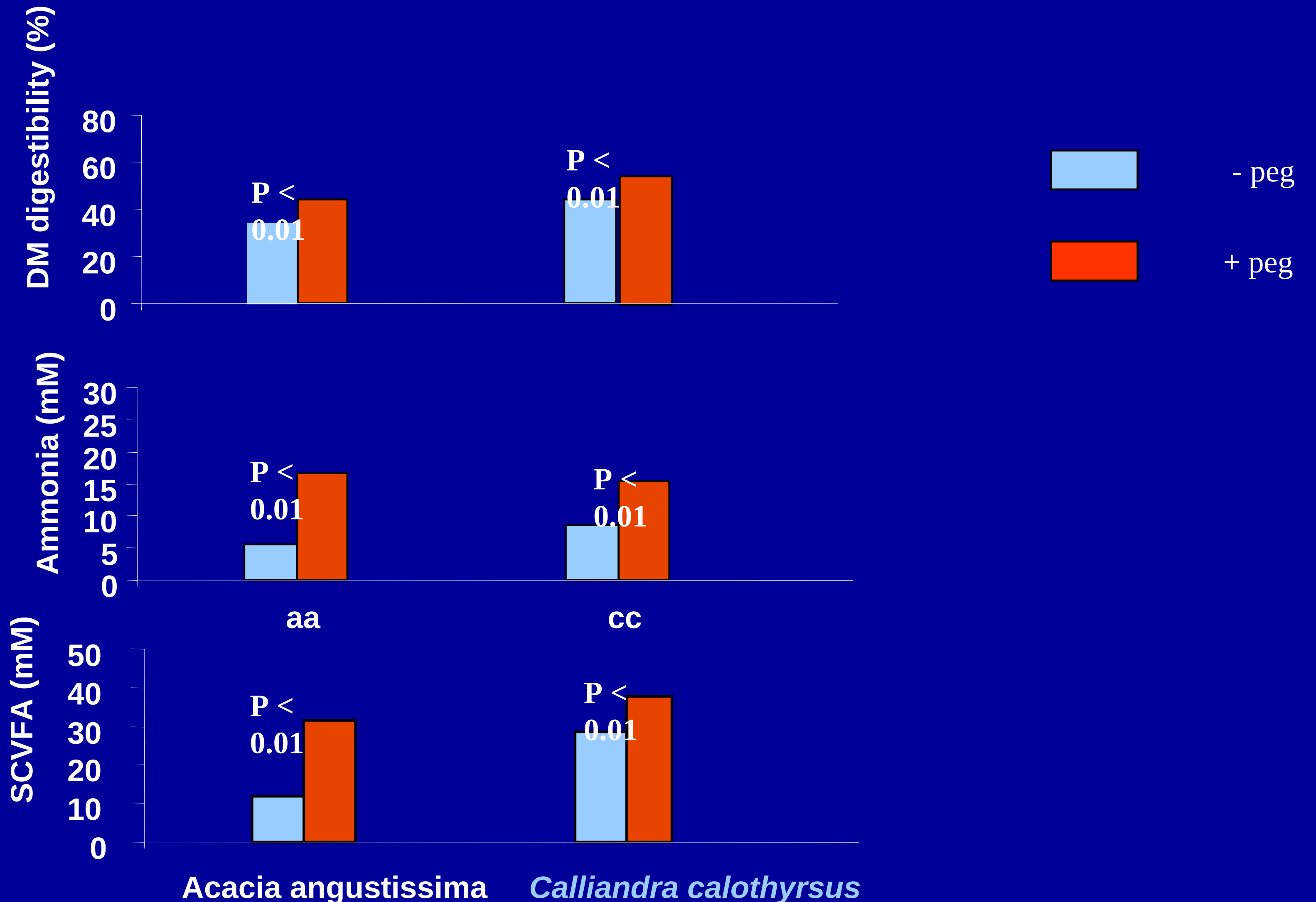
Calliandra calothyrsus

（朱樱花）

Condensed tannins in *A. angustissima* and *Calliandra calothyrsus*

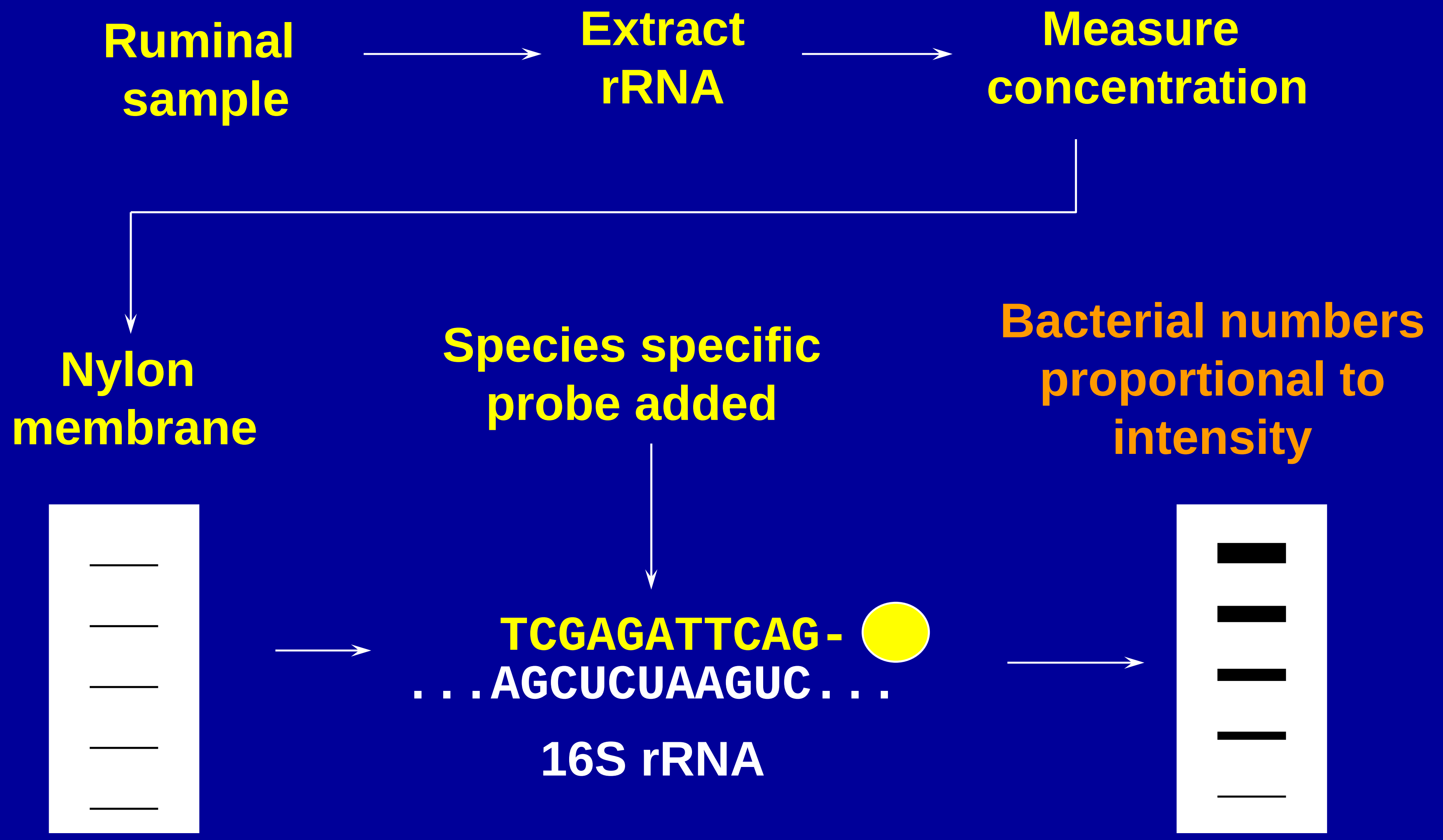
Tannin	Acacia	Calliandra
Total (%DM)	20.0	12.0
Free	98.9	84.2
Bound	1.1	15.7

In-vitro rumen fermentation of *Acacia angustissima* and *Calliandra calothyrsus*



What is the effect of Tannins on the

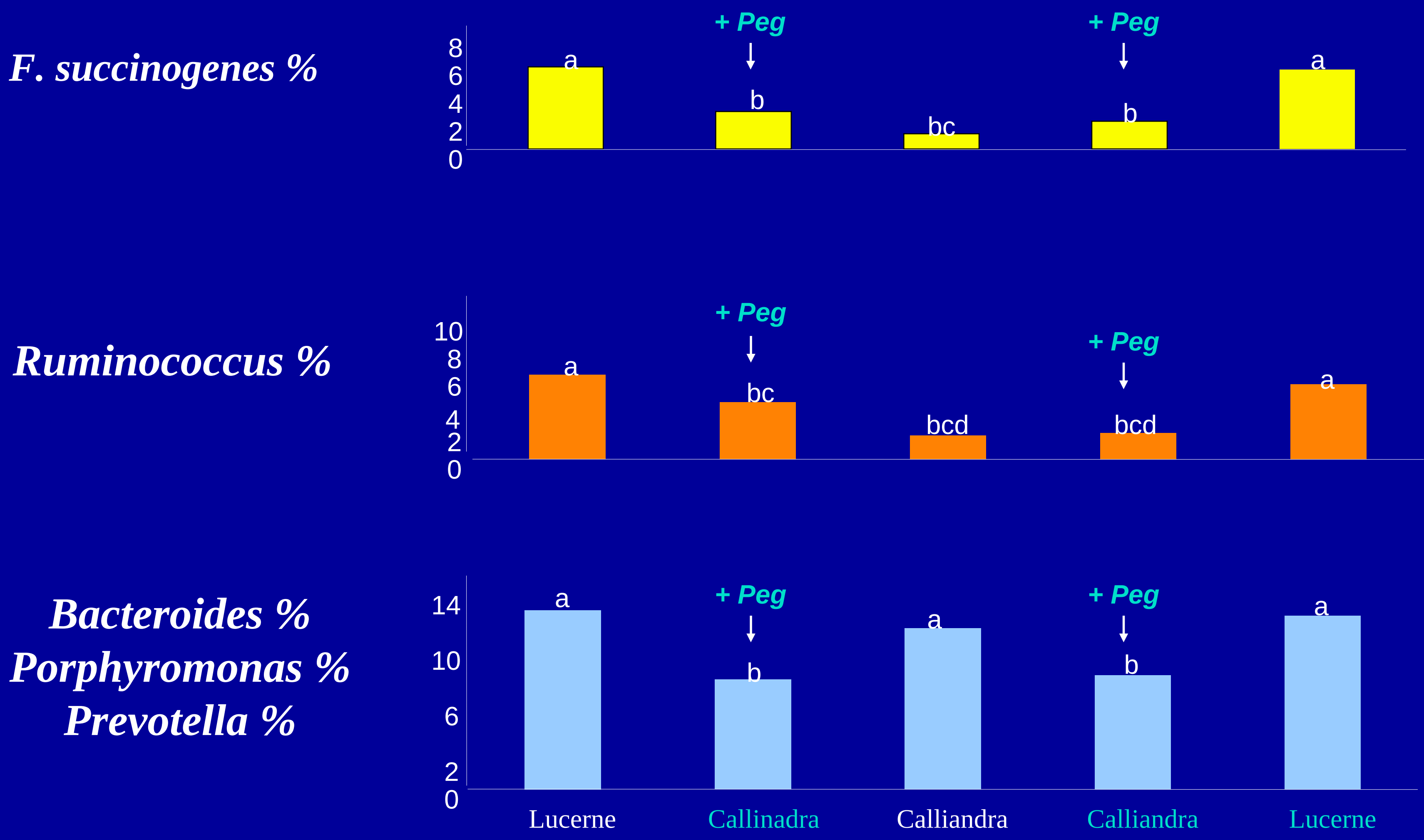
the rumen microbial ecology ?


Ruminal sample
Extract rRNA
Measure concentration
Nylon membrane
Species specific probe added
Bacterial numbers proportional to intensity
TCGAGATTCAG-
...AGCUCUAAGUC...
16S rRNA

Effect of calliandra tannins on protozoal, fungal and cellulytic populations

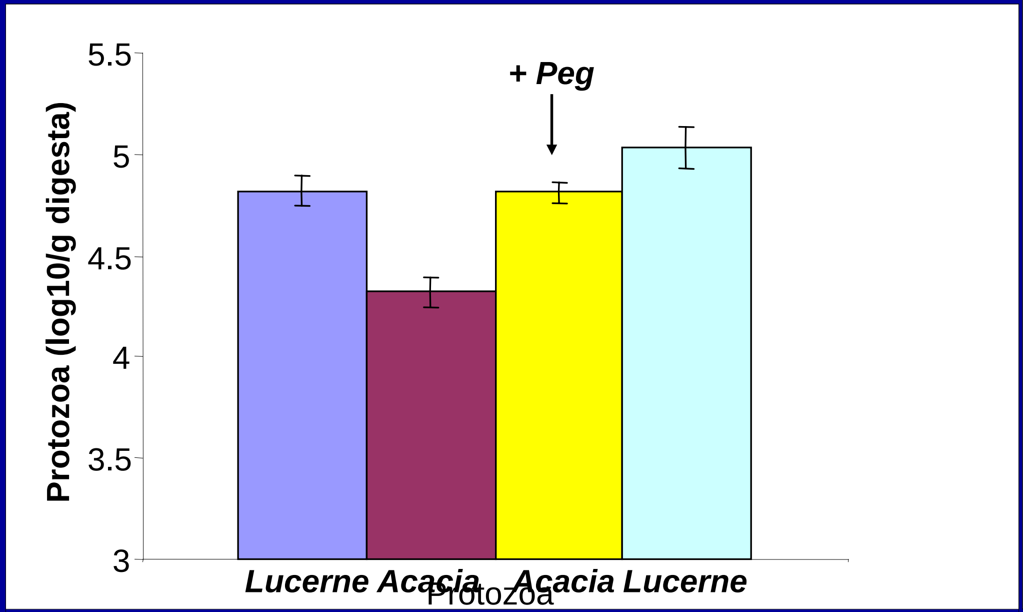
Microbial #'s	Calliandra	Call+PEG	Lucerne	Luc+PEG
Protozoa (log_{10})	4.6	4.4		
Fungi (log_{10})	3.1	2.7	3.5	3.5
Fungi (% total)	0.06	0.05	0.09	0.08
Cellulytics (log_{10})	7.4	9.4	8.7	8.7
Fibrobacter (% total)	3.3	8.6*	10.6	9.8
Ruminococcus (% total)	5.8	13.0*	11.5	13.5

Effect of Tannin on Rumen Microbial Populations (percentage of total 16S rRNA)

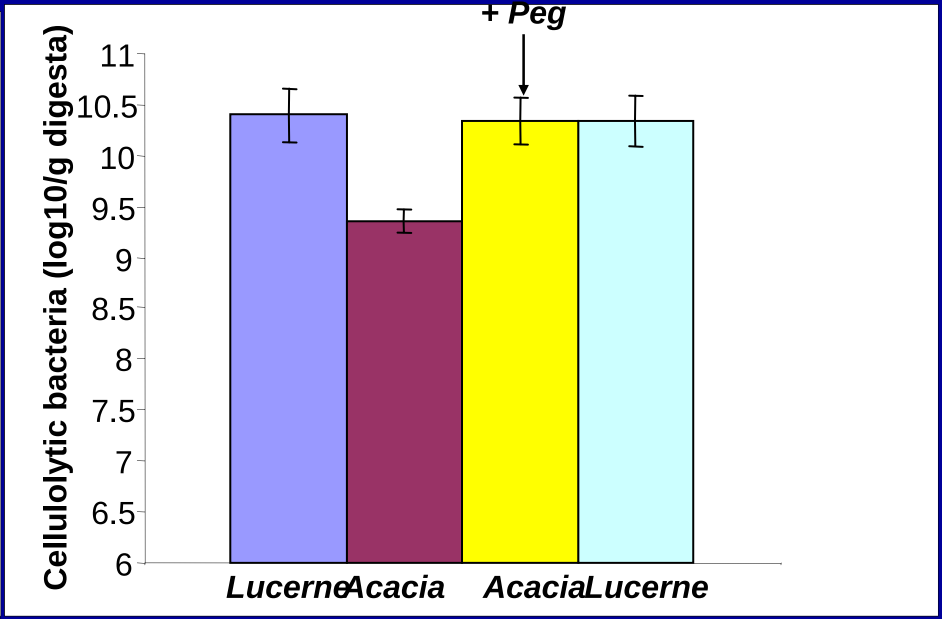


Effect of Acacia tannins on protozoal and cellulolytic bacterial populations
(Conventional enumeration)

Protozoa



Cellulolytic bacteria



tannins

↓ !

changes in microbial populations

↓ ?

the microbial protein synthesis

Efficiency of rumen microbial protein synthesis

Treatment	Microbial Purine Excretion (mmol/d)	Rumen Microbial N	
		g N/d	g N/kg DOMR
Grass	7.5[a]	6.3	29.3
Grass+C	8.3[ab]	7.0	28.0
Grass+C+Peg	9.1[b]	7.8	29.2
Grass+L	9.4[b]	8.0	31.5
Grass+L+Peg	9.0[b]	7.4	27.6

C, calliandra (30%); L, lucerne (30%)

Effect of Leucaena Tannins on Microbial Protein Synthesis

(McNeill *et al*, unpublished)

Treatment	MCP (g/d)	MCPS efficiency (g/kg DOMI)	
Leucaena leucocephala (CT = 7.3 %)			
CT active	110	193	*nsd*
CT neutralised	116	192	
Leucaena KX2 (CT = 12.9 %)			
CT active	61	137	*nsd*
CT neutralised	66	126	

(P< 0.05)

Conclusions

- Tannins alter microbial ecology
- Quantitation of bacteria by molecular techniques is a new powerful tool for future research
- Tannins may limit productivity by primarily complexing with nutrients rather than inhibiting microbial activity

3 Probiotics for ruminants

Probiotics are now replacing the chemical growth promoters

- increased growth rate
- improved milk yield and quality
- improved feed conversation
- Improved resistance to disease

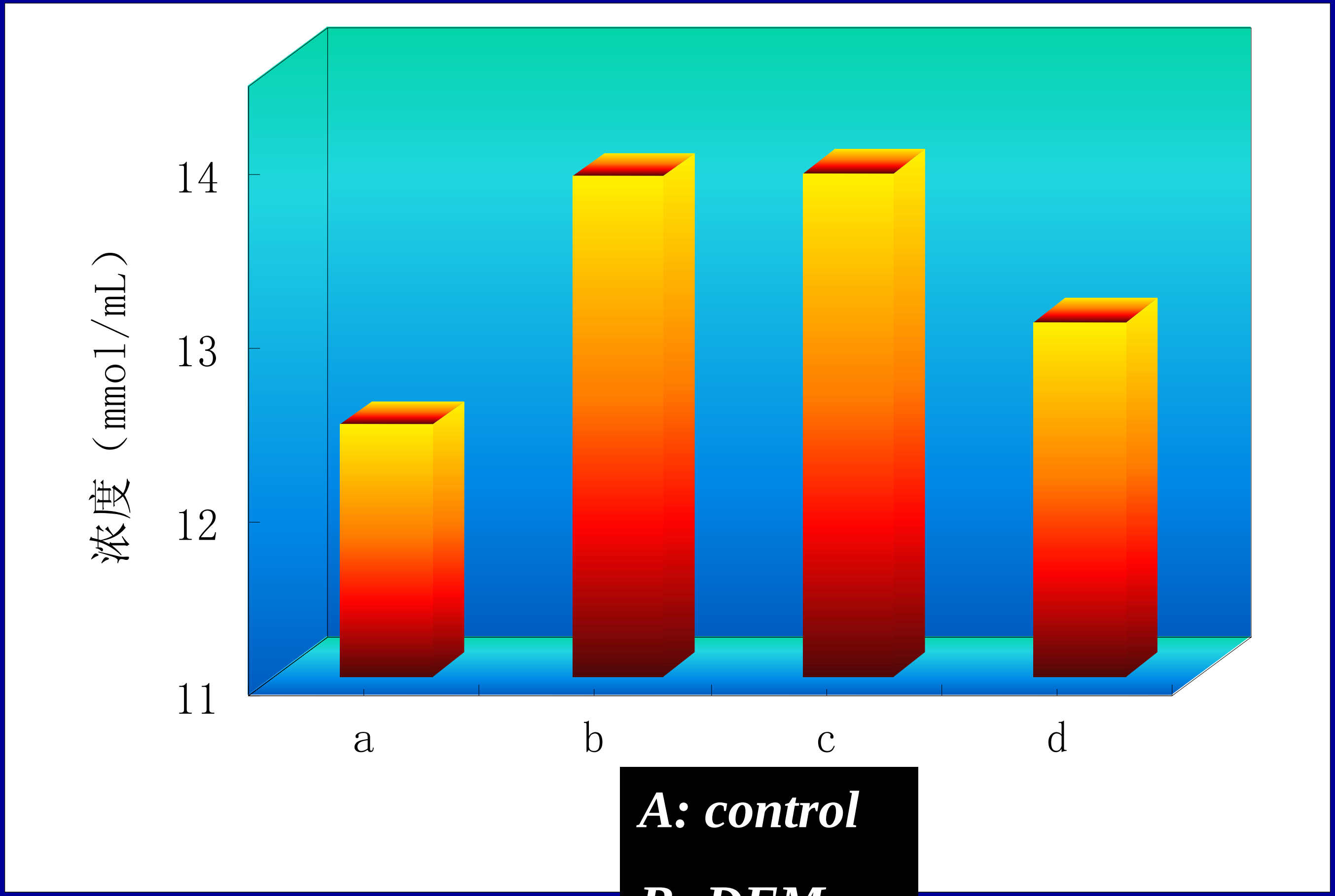
3 Probiotics for ruminants

- lactic acid-producing bacteria
  - L. acidophilus
  - Streptococcus faecium
- yeast culture or active dry yeast
  - Saccharomyces cerevisiae

Effect of Yeast Culture On Rumen Fermentations

	Control	Yeast
pH	6.66	6.73
Anaerobic bacteria, 109 CFU/ml	2.72	6.47
Cellulytic bacteria, 107 CFU/ml	2.77	8.20
Lactate-utilizing bacteria, 108 CFU/ml	3.96	4.59
Rate of lactate utilization, mmoles/L/hr	1.83	2.49

NH3-N at 2 hr after feeding



A: control

B: DFM

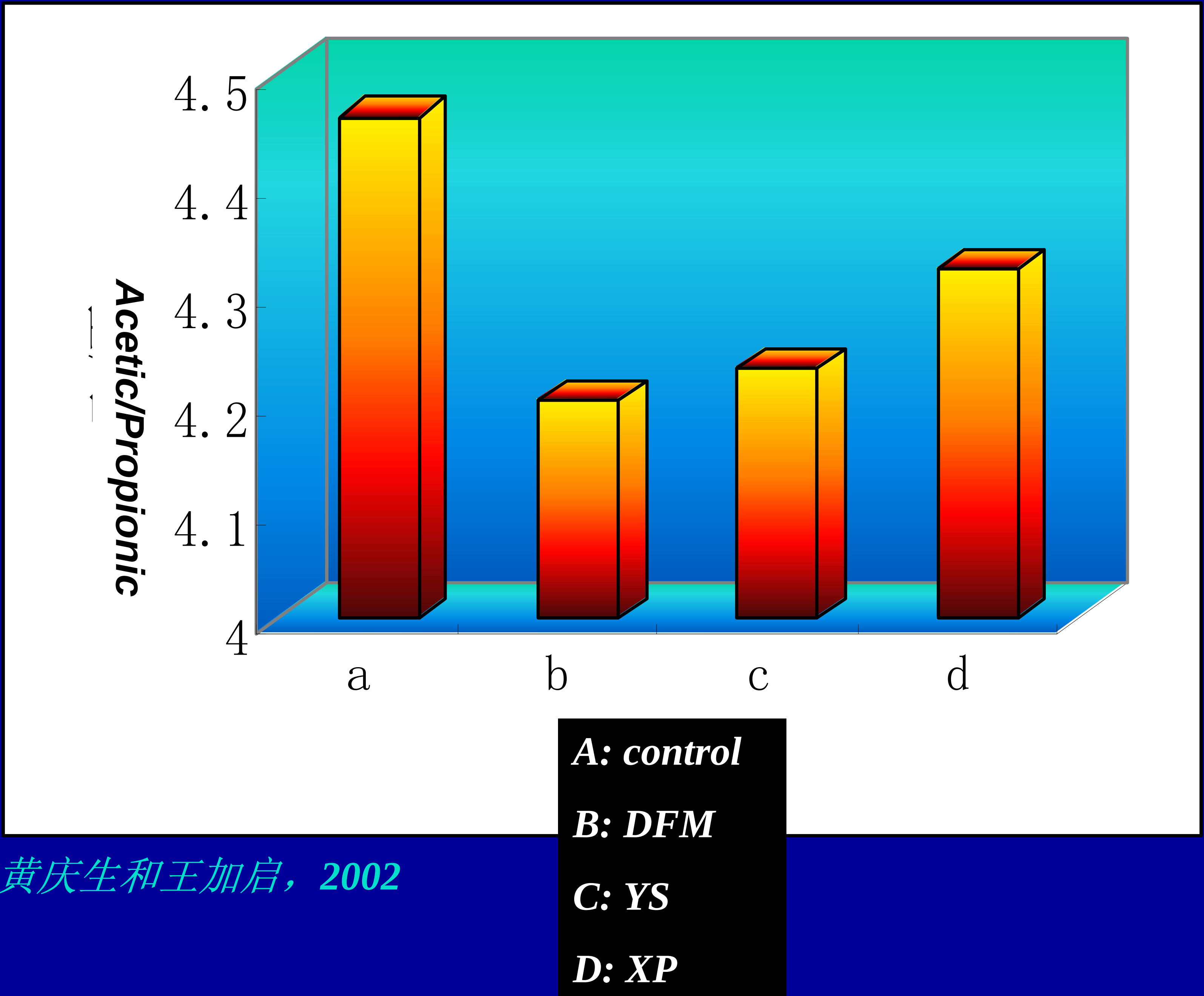
C: YS

D: XP

*黄庆生和王加启，**2002***

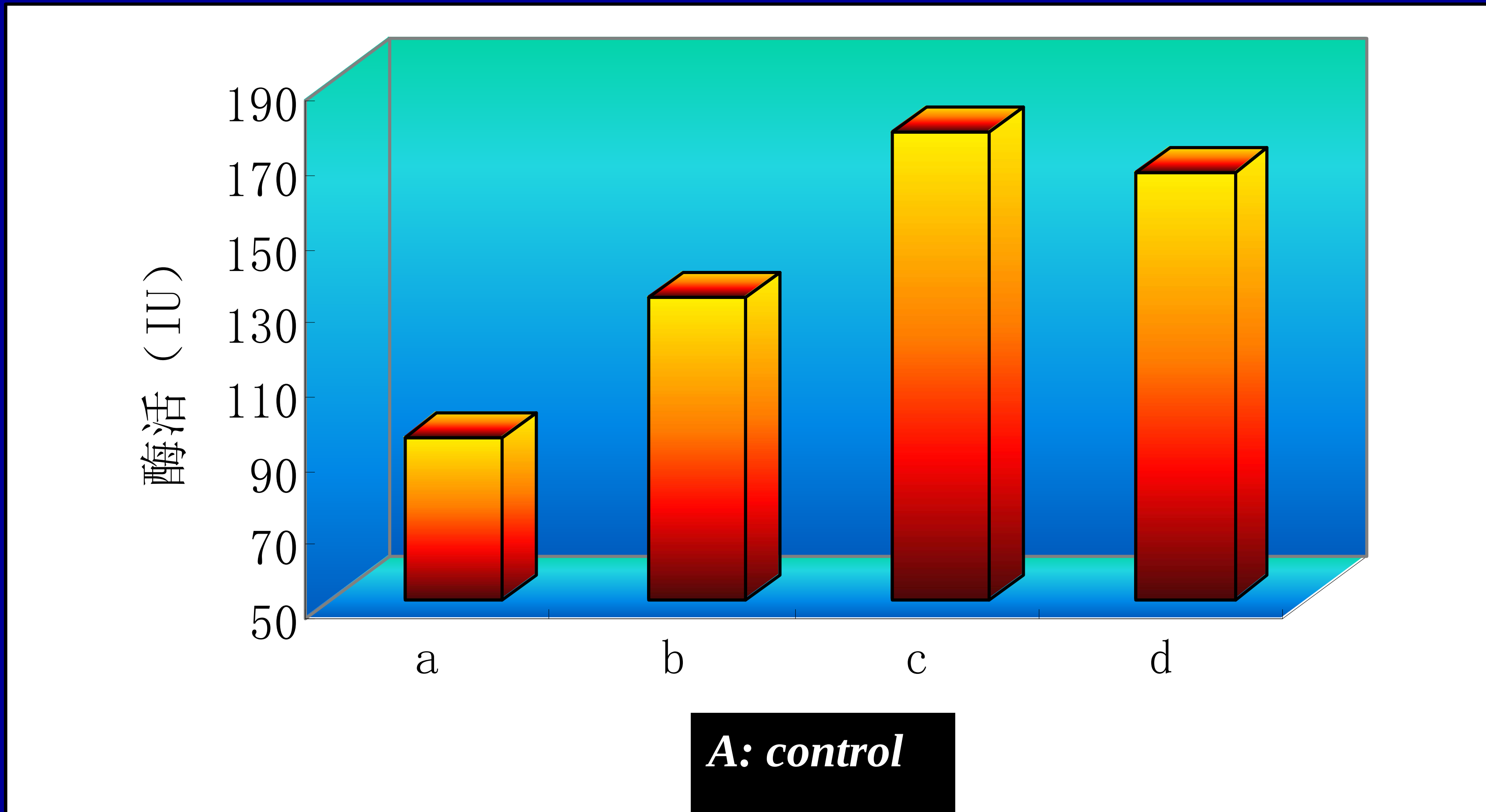
groups	acetic	propionic	butyric	TVFA
CT	64.18 [b]	14.43 [b]	9.89 [b]	88.50 [b]
DFM	64.33 [b]	15.43 [b]	10.57 [ab]	90.33 [b]
YS	69.34 [a]	16.49 [a]	11.19 [a]	97.00 [a]
XP	63.83 [b]	14.89 [b]	10.17 [b]	88.88 [b]
p<	0.0486	0.0016	0.0021	0.0210
SEM	4.950	1.176	0.763	6.732

黄庆生和王加启，2002



黄庆生和王加启，2002

Activities of CMC-lase



A: control

B: DFM

C: YS

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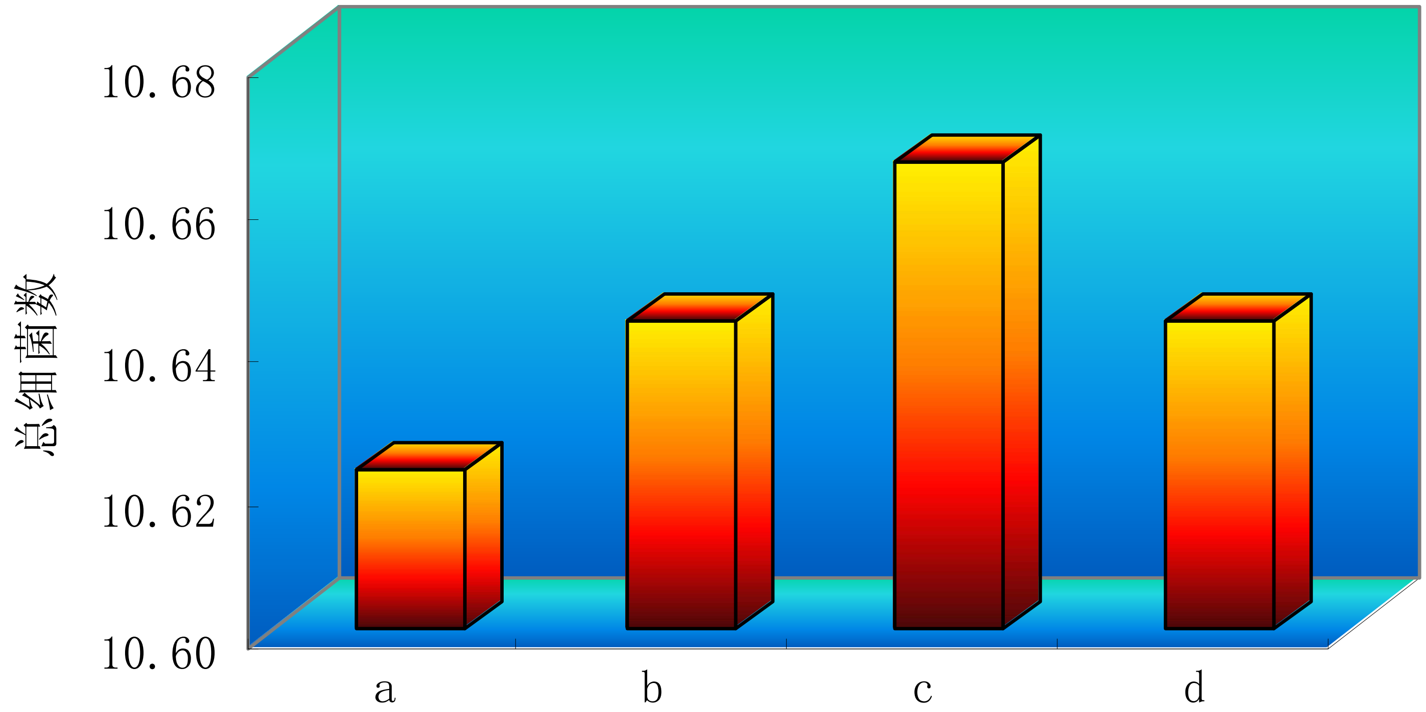
Total bacterial count



A: control

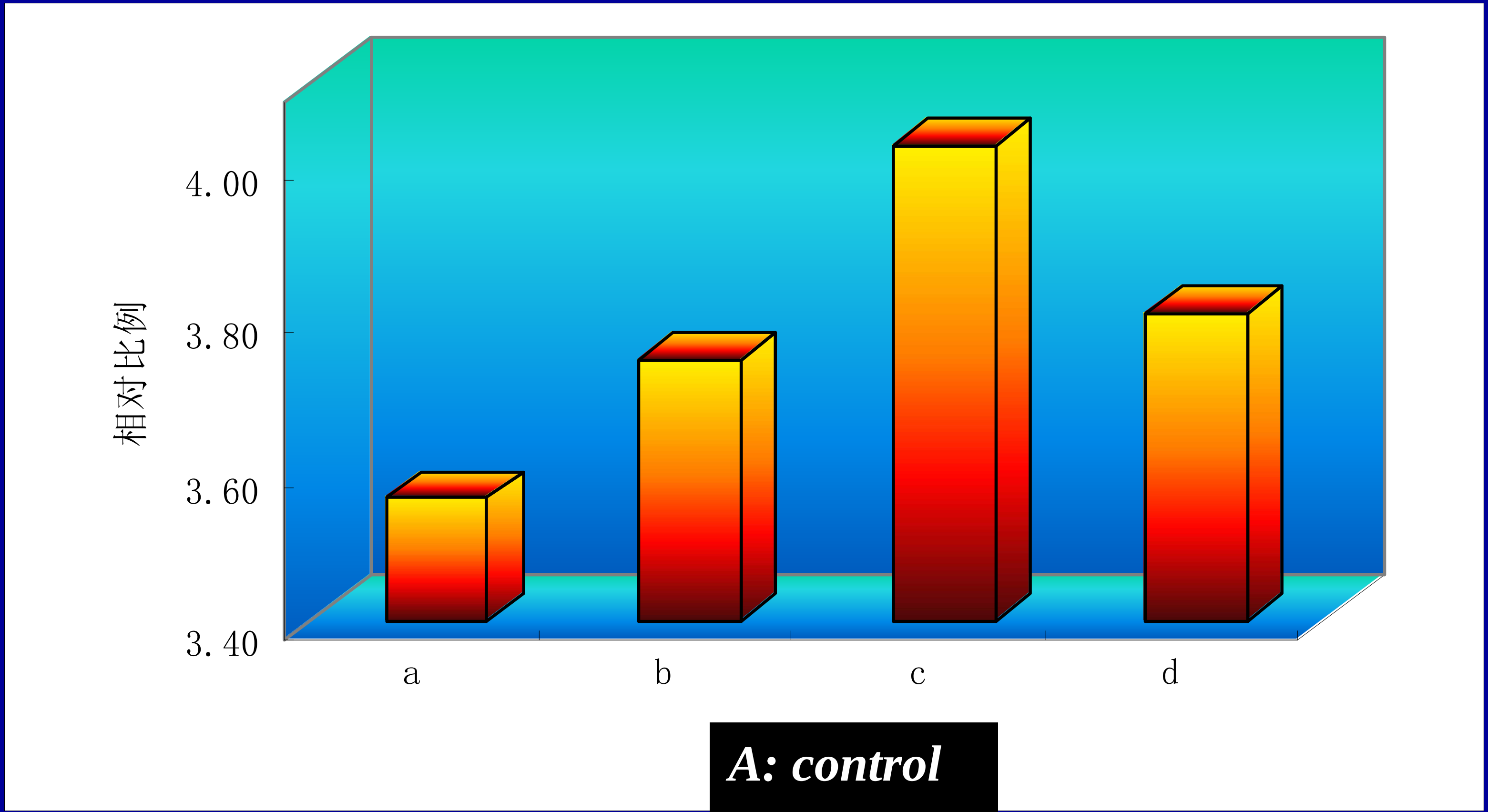
B: DFM

C: YS

D: XP

*黄庆生和王加启，**2002***

Total cellulytic bacterial count



黄庆生和王加启，2002

A: control

B: DFM

C: YS

D: XP

DFM for beef cattle feeding

	DFM	Control
Head of cattle	20	20
BW at begin（kg）	320.75	323.60
BW at end（kg）	359.15	349.90
BWG（kg/d）	1.13	0.77
Concentrate:BWG	2.66： 1	3.90： 1

黄庆生和王加启，2002

DFM for milking cows

	DFM	Control	
Head of cattle	19	19	
Increase of milk(kg/d)	1.79	0.06	
Milk fat (%)	3.53	3.39	

黄庆生和王加启，2002

Conclusions for probiotics

- Change rumen fermentation pattern
- Increase total and cellulytic bacteria
- Improve animal productivity

CONCLUSION

Microbiological Technology in Feed industry for Ruminants

- **Active**
- **Effective**
- **Promising**

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THANK YOU