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Comparison among soybean seeds and rapeseed cake included in diets with two different CP levels using gas production technique

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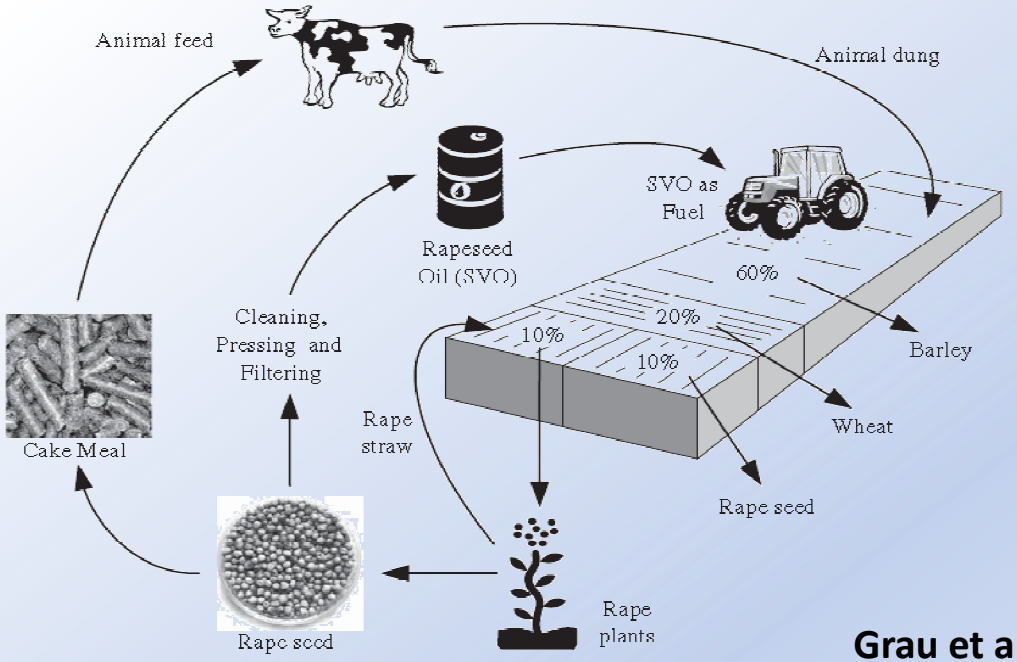
Introduction

- ✓ High cost of soybean and by-products has increased the interest for alternative protein sources (i.e. rapeseed cake)
- ✓ Cold oil extraction process "on farm" provides rapeseed cake for animal feeding and oil as bio-fuel
- ✓ Possible problems related to high lipids content of rapeseed cake (15-20% DM)

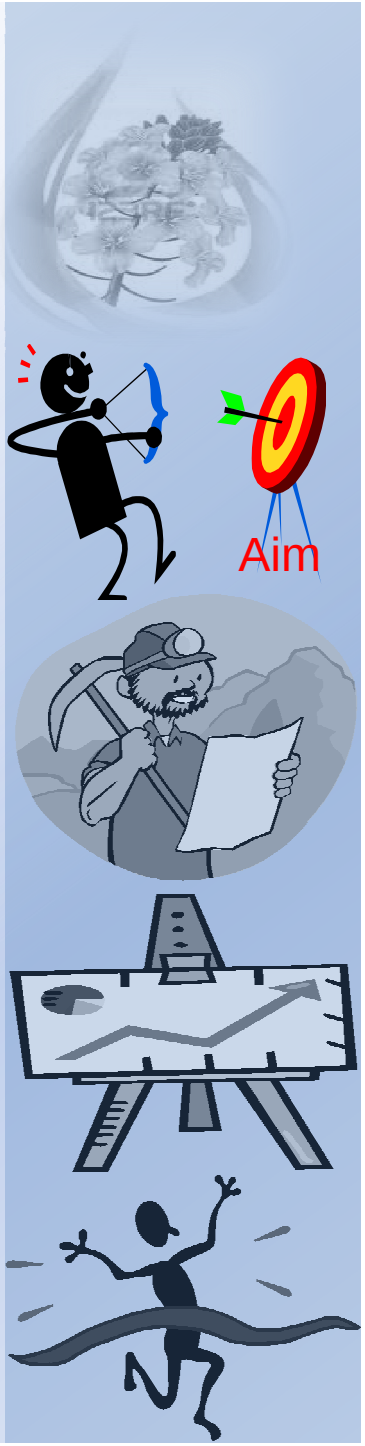


Grau et al., 2009

Aim

To evaluate *in vitro* fermentation of diets with different protein sources at different inclusion levels:

protein sources	protein levels
soybean meal	11% CP
soybean seeds	11 and 15 % CP
rapeseed cake	11 and 15 % CP



Ingredients of experimental diets

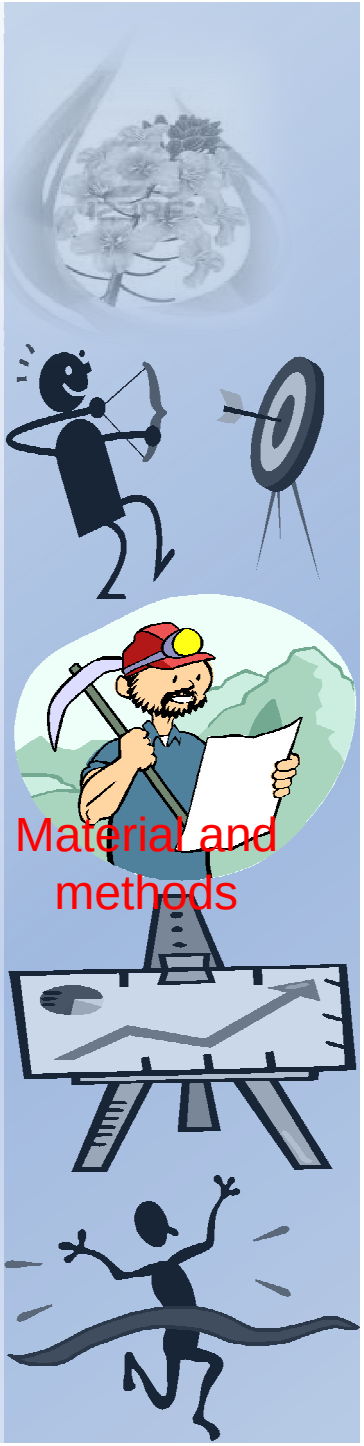
Feed (% DM)	Low inclusion (L)			High inclusion (H)	
	L_SBM	L_SBS	L_RSC	H_SBS	H_RSC
Corn silage	38.2	37.4	36.7	32.9	31.4
Corn meal	33.7	33.1	32.5	29.1	27.8
Dry beet pulp	12.4	12.2	11.9	10.7	10.2
Wheat bran	2.8	2.7	2.7	2.4	2.3
Wheat straw	4.7	4.6	5.5	4.0	3.9
Premix	3.2	3.1	3.0	2.7	2.6
Soybean seed	-	6.9	-	13.8	-
Rapeseed cake	-	-	6.9	-	14.2
Soybean meal	5.1	-	1.8	-	7.7

L_SBM: low inclusion of soybean meal
L_SBS: low inclusion of soybean seeds
L_RSC: low inclusion of rapeseed cake
H_SBS: high inclusion of soybean seed
H_RSC: high inclusion of rapeseed cake

Chemical composition (% DM) of experimental diets

	Low inclusion (L)			High inclusion (H)	
	L_SBM	L_SBS	L_RSC	H_SBS	H_RSC
CP	10.9	10.9	10.9	14.7	14.7
Starch	36.4	35.8	35.8	32.0	32.0
Lipids	3.4	4.6	4.6	5.7	5.7
NDF	33.3	32.8	33.6	30.5	32.1
NSC	44.6	43.6	42.2	40.9	40.0

L_SBM: low inclusion of soybean meal
L_SBS: low inclusion of soybean seeds
L_RSC: low inclusion of rapeseed cake
H_SBS: high inclusion of soybean seed
H_RSC: high inclusion of rapeseed cake

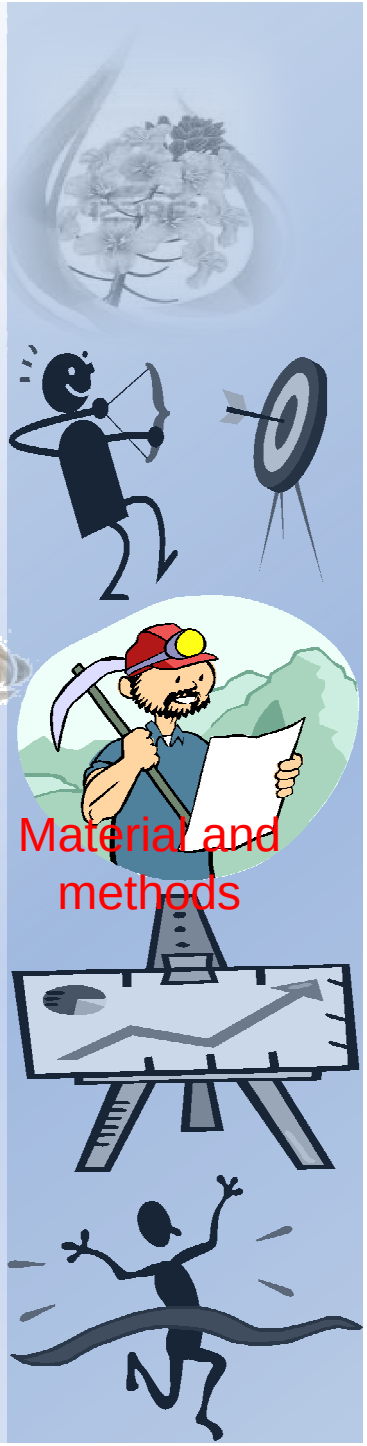


Gas production technique

Procedure of incubation:

- **48 bottles (capacity 250 ml)**

- **0.5 g of diet + 10 ml rumen fluid + 65 ml buffer/bottle (Menke et al., 1979)**
- **Under anaerobic conditions at 39°C**
- **Kinetics of GP (Groot et al., 1996)**



Experimental design

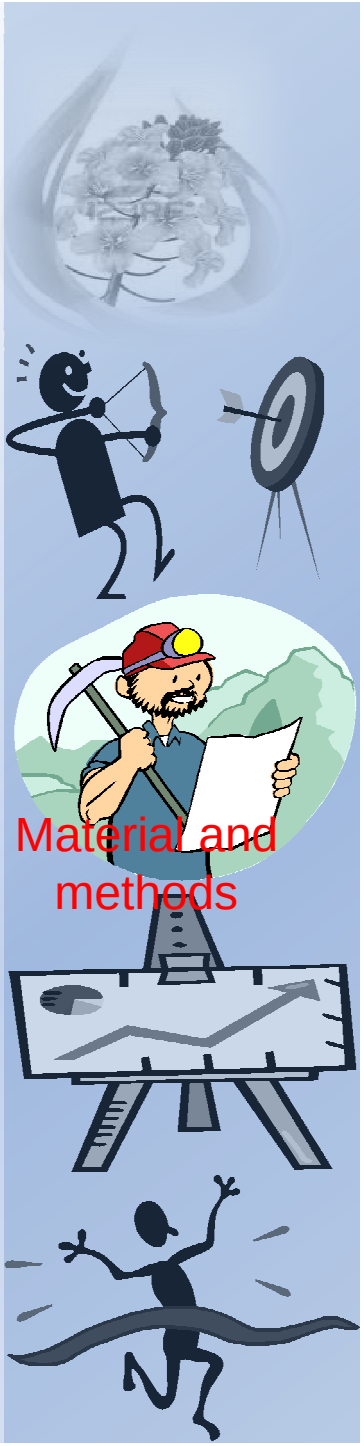
5 diets x 8 replications + 8 blanks* = 48 bottles

*bottle without diet

Times of incubation:

- 16 h → products of fermentation 24 bottles
- 72 h → kinetics of gas production 24 bottles

t1/2 is the time of incubation at which half of the asymptotic GP is obtained (Blummel et al., 1998)



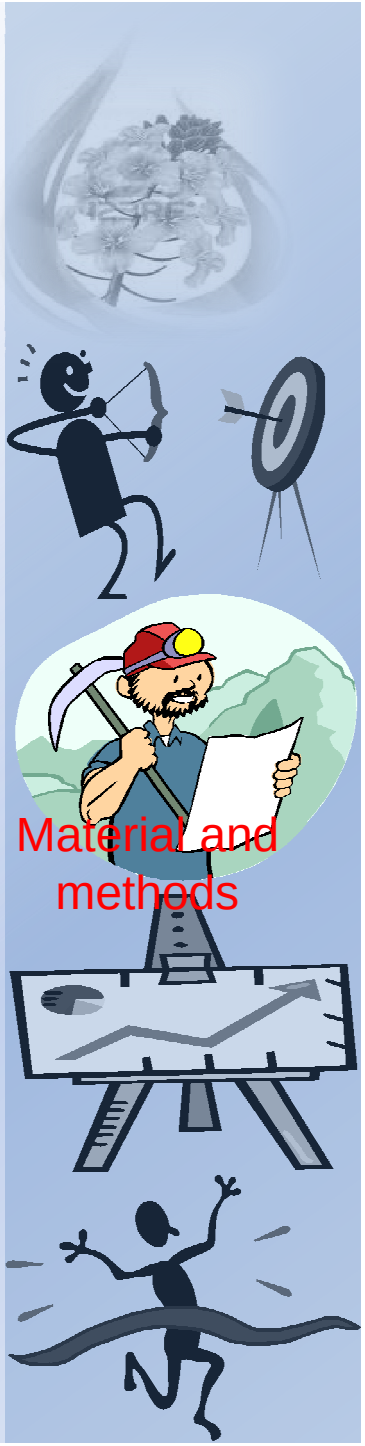
Analyses

Measurements at 16 h of incubation:

- **Residual NDF**
- **Ammonia, VFAs, pH**

Degradabilities computation (van Soest, 1991):

- **NDFd, % NDF = $\frac{(\text{NDFsample} - \text{NDFresidue})}{\text{NDFsample} \times 100}$**
- **TDMd, % DM = $\frac{(\text{DMsample} - \text{NDFresidue})}{\text{DMsample} \times 100}$**



Statistical model

ANOVA (SAS, 2005)

$$y_{il} = \mu + A_i + e_{il}$$

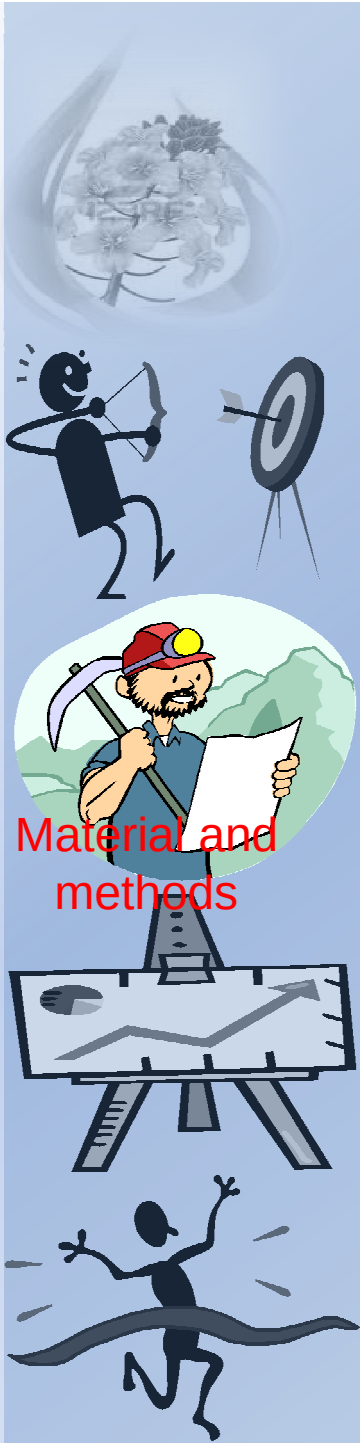
y_{ij}= single observation;
μ = overall mean;
A_i = fixed effect of diet (i = 1,…,5);
e_{ij} = random residual ~ $N(0,\sigma^2_e)$

Contrasts among diets:

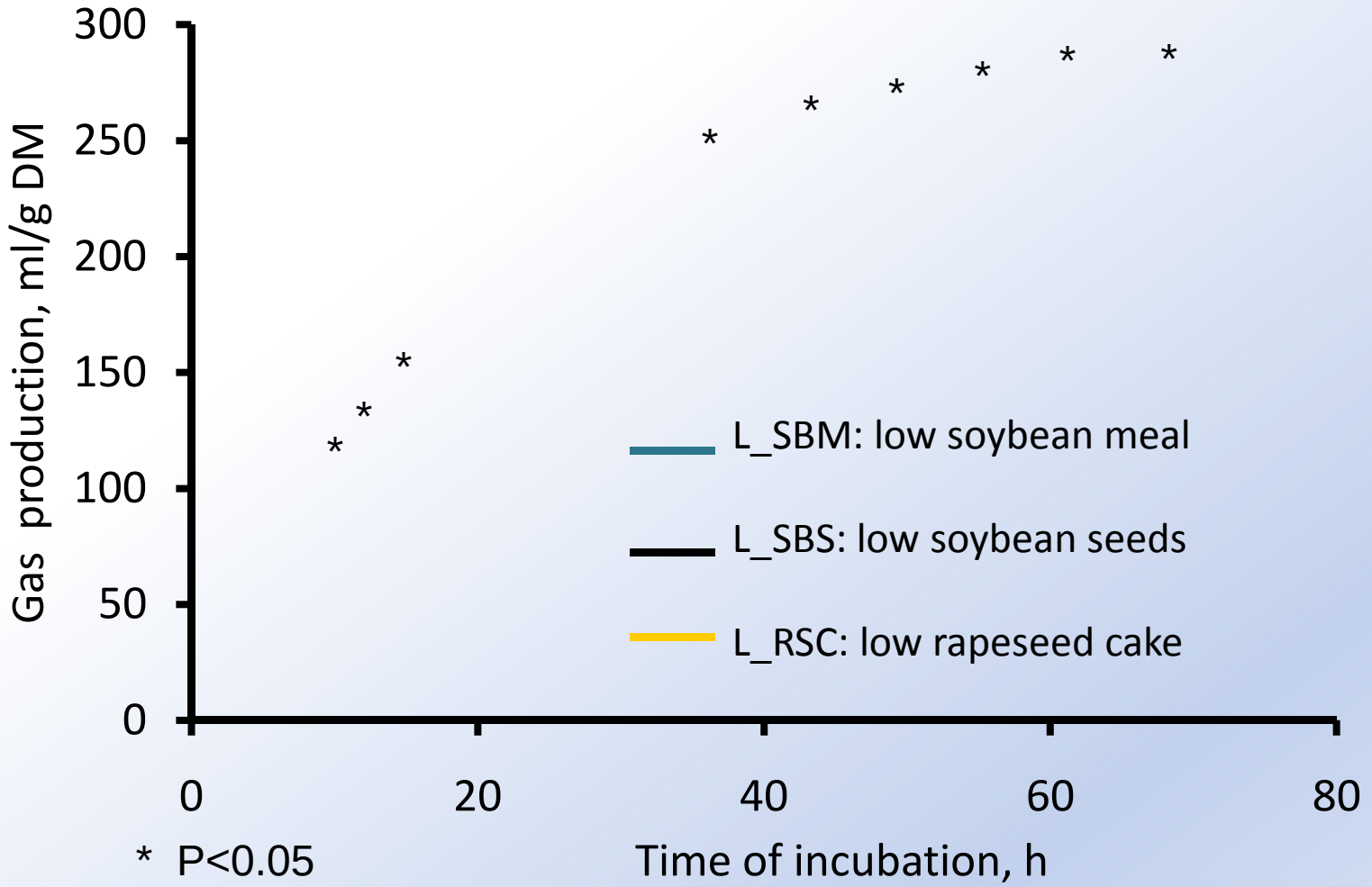
L_SBM vs L_SBS
L_SBM vs L_RSC
L_SBS vs L_RSC
→ protein source effect

(L_SBS + L_RSC) vs (H_SBS + H_RSC) → inclusion level effect

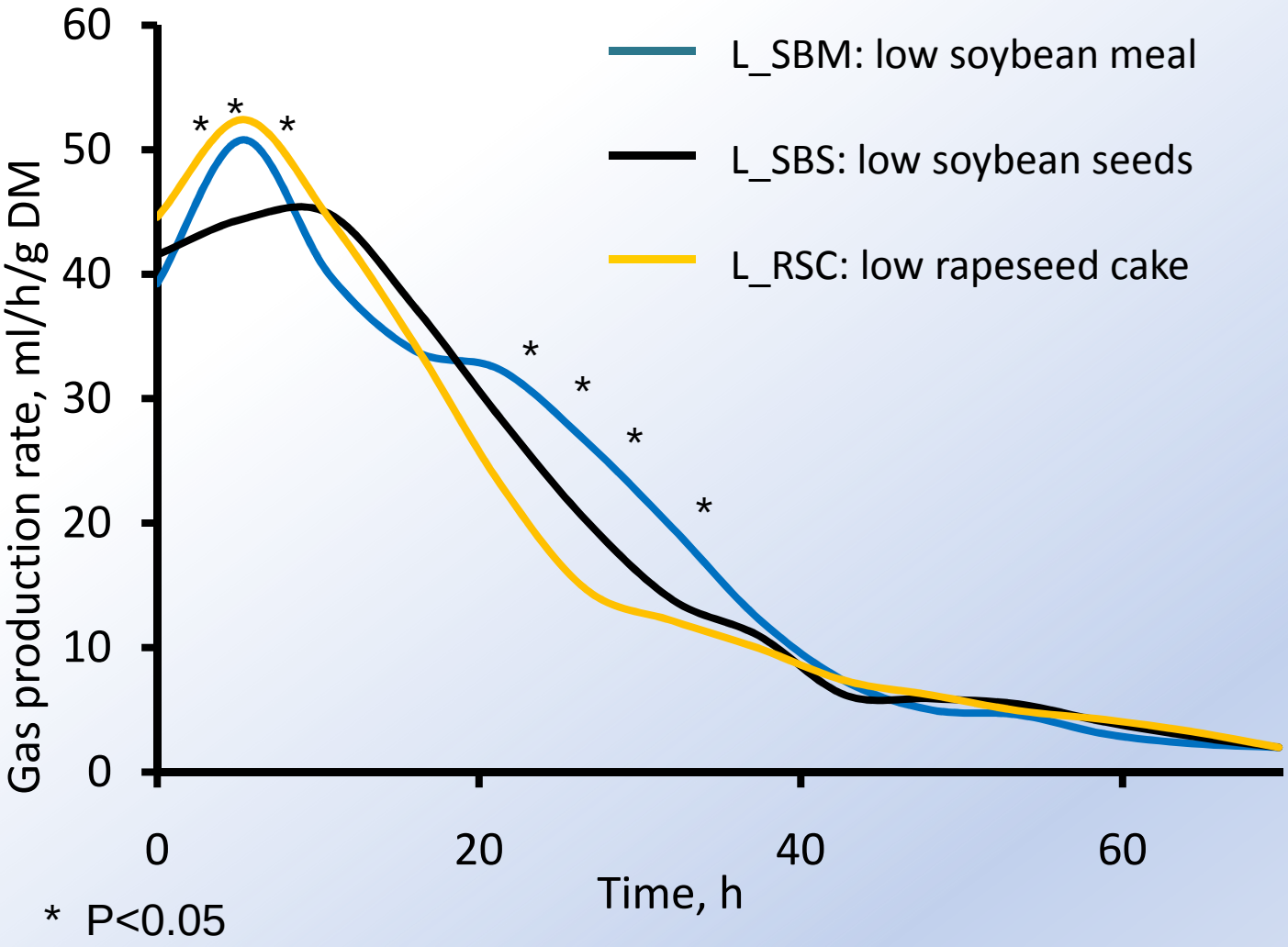
(L_SBS + H_SBS) vs (L_RSC + H_RSC) → soybean seed vs. rapeseed cake



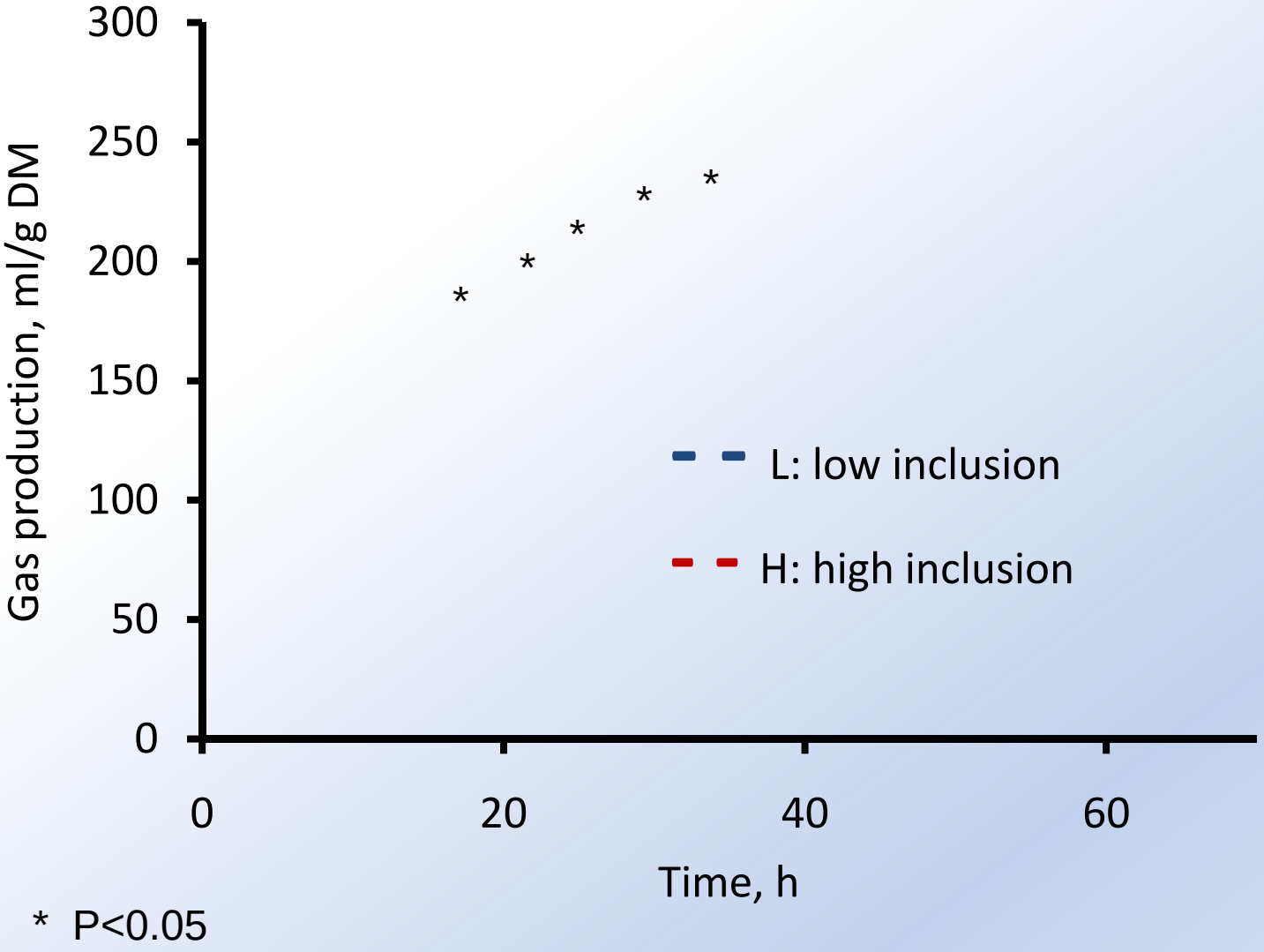
Protein sources at low inclusion: effect on total GP



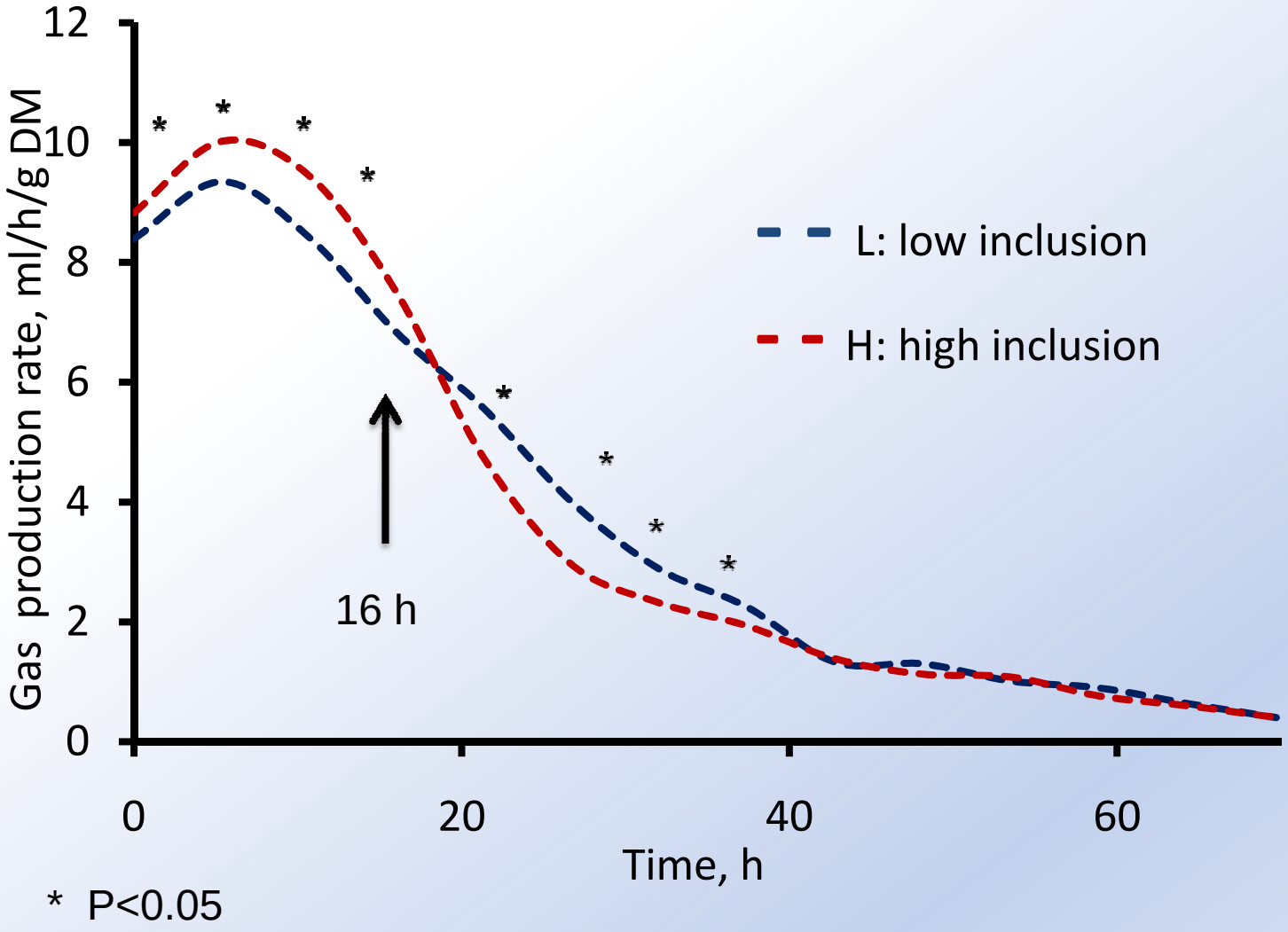
Protein sources at low inclusion: effect on GP rate



Inclusion level: effect on total GP



Inclusion level: effect on GP rate



Degradability of diets at 16 h

	Low inclusion (L)			High inclusion (H)		Contrast, *P*		
	L_SBM	L_SBS	L_RSC	H_SBS	H_RSC	L vs H	SBS vs RSC	SED
NDFd (% NDF)	23.2	20.5	24.0	19.3	25.3	0.04	0.05	2.33
TDMd (% SS)	70.9	70.4	72.0	71.0	73.1	0.04	<0.01	0.87

L_SBM: low inclusion of soybean meal
L_SBS: low inclusion of soybean seeds
L_RSC: low inclusion of rapeseed cake
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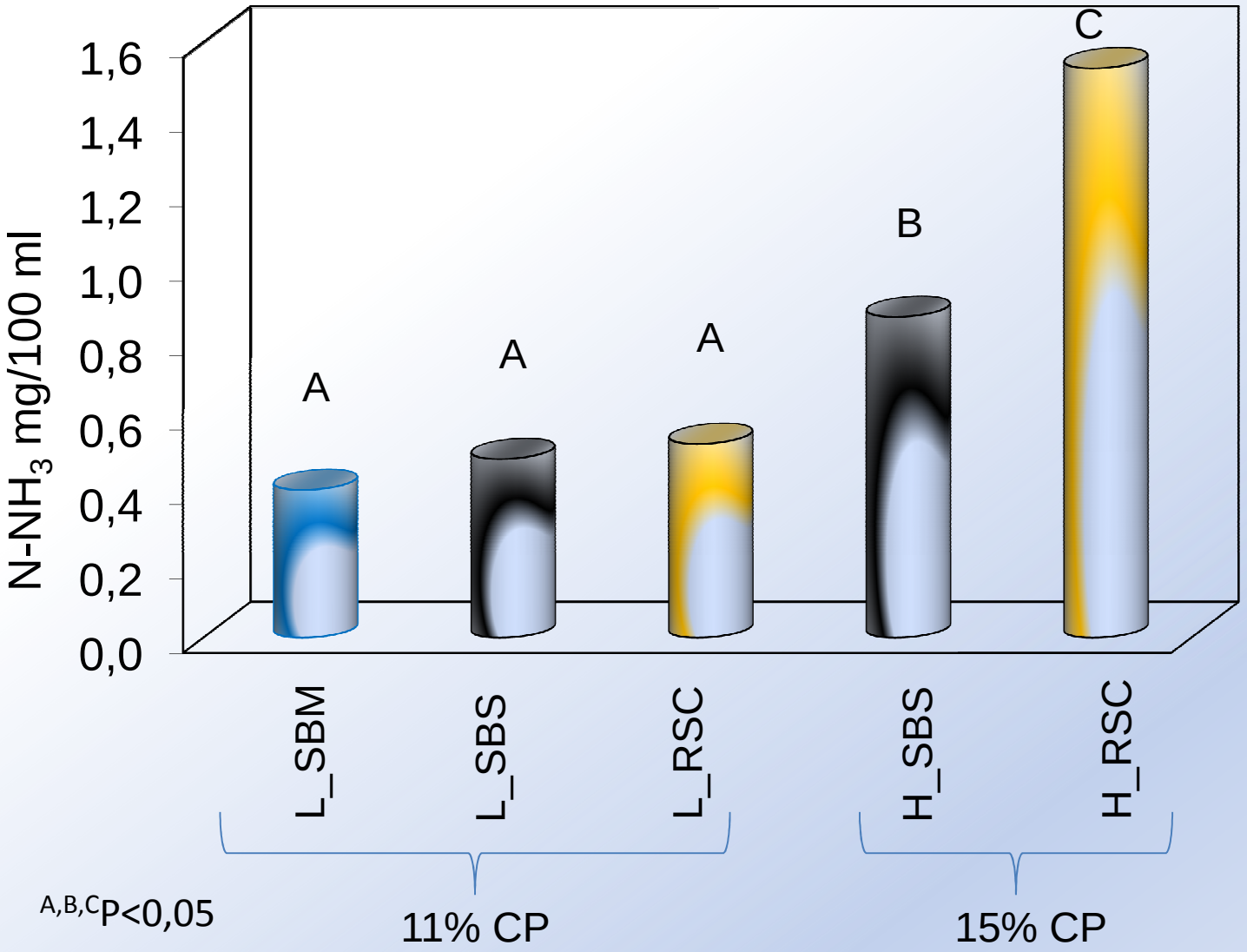
Ammonia concentration at 16h



Conclusions

The reduction of CP level in the diets from 15 to 11% decreased the rate of GP and DM degradability at 16 h

Rapeseed cake can be considered a suitable source of protein in diets for ruminants leading a higher rate of degradation in the first hours of incubation compared to soybean seed.

Implications

Rapeseed cake obtained “on farm” could be an alternative to soybean seed in low protein diets, due to high protein degradation rate.

The small-scale production of oil from rapeseed could be interesting for the positive effects on the environmental impact and feeding costs obtained by the inclusion of rapeseed cake in ruminant diets.