Ruminal fermentation and *in sacco* NDF degradability in growing bull calves fed different starch levels and two types of roughage

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Introduction (I)

- In Denmark, dairy breed bull calves are utilized for rose' veal production
- Calves are bought from dairy farms at 2-4 weeks old
- Fed milk, concentrate and straw/hay until week 6-8 of age and weaned
- Fed high starch concentrate *ad libitum* and barley straw as only roughage
- Premium payment (+50 to 60 cent/kg carcass) is received when calves are:
  - Less than 10 months
  - Carcass weight: 160-200 kg (in practice > 185 kg to get EU male premium)
  - EUROP conformation: > 3.3

Introduction (II)

- Calves grow > 1250 g/day from 2 weeks to slaughter (>1350 g/day in some herds)
- There is a risk of subacute acidosis in such intensively-fed bull calves
- Bloat, rumen parakeratosis, large fluctuations in daily intake, and liver abscesses can develop
- On average 12% liver abscesses in this type of production

- There is a need for finding feeding regimes that reduce these risks but still keep daily gain high

Objective

- **Investigate how:**
  - Changed composition of the concentrate (i.e. less starch an more fiber (NDF))
  - Roughage type (Grass hay *vs.* Barley straw)
- **will affect:**
  - Rumen fermentation (pH and VFA)
  - In sacco NDF degradability
- **in growing bull calves**

Material and Methods

Animals and Design

- 6 ruminally fistulated calves (initial BW 120 ± 3 kg)
- were randomly assigned to one of 4 treatments in a balanced incomplete 2 x 2 factorial experiment with 4 consecutive periods

Treatments:

- Low starch (**LS**) or high starch (**HS**) concentrate
- Barley straw (**BS**) or grass hay (**GH**) as roughage
- Concentrate and roughage were offered *ad libitum* and separately

Design and treatments

Calf#	Period 1	Period 2	Period 3	Period 4
5418	HS-BS	HS-GH	LS-GH	LS-BS
5421	LS-BS	HS-BS	HS-GH	LS-GH
5425	HS-GH	LS-GH	LS-BS	HS-BS
5426	LS-GH	LS-BS	HS-BS	HS-GH
5433	HS-GH	LS-GH	LS-BS	HS-BS
5442	LS-BS	HS-BS	HS-GH	LS-GH

Periods were 21 days (14 d for adaptation + 7 d for measurements and sampling

Composition of concentrates

% of DM	LS	HS
Wheat	20.5	30.5
Barley	20.5	30.5
Soybean meal	21.5	24.7
Dried sugar beet pulp	18.6	5.3
Grass pellets, plus[1]	10.5	-
Sugar beet molasses	2.6	2.6
Rape seed oil	2.3	2.3
Mineral-Vitamin[2]	3.2	3.0
Limestone	0.3	1.1
DM %	**88.9**	**89.1**
Starch, % of DM	**28.0**	**40.2**
NDF, % of DM	**19.8**	**14.1**
DE, MJ per kg DM	**15.5**	**15.7**

Nutritive value of roughages

% of DM	BS	GH
Feed analysis		
DM %	85.0	90.0
Starch, % of DM	-	-
NDF, % of DM	82.8	53.8
DE, MJ per kg DM	8.2	12.8

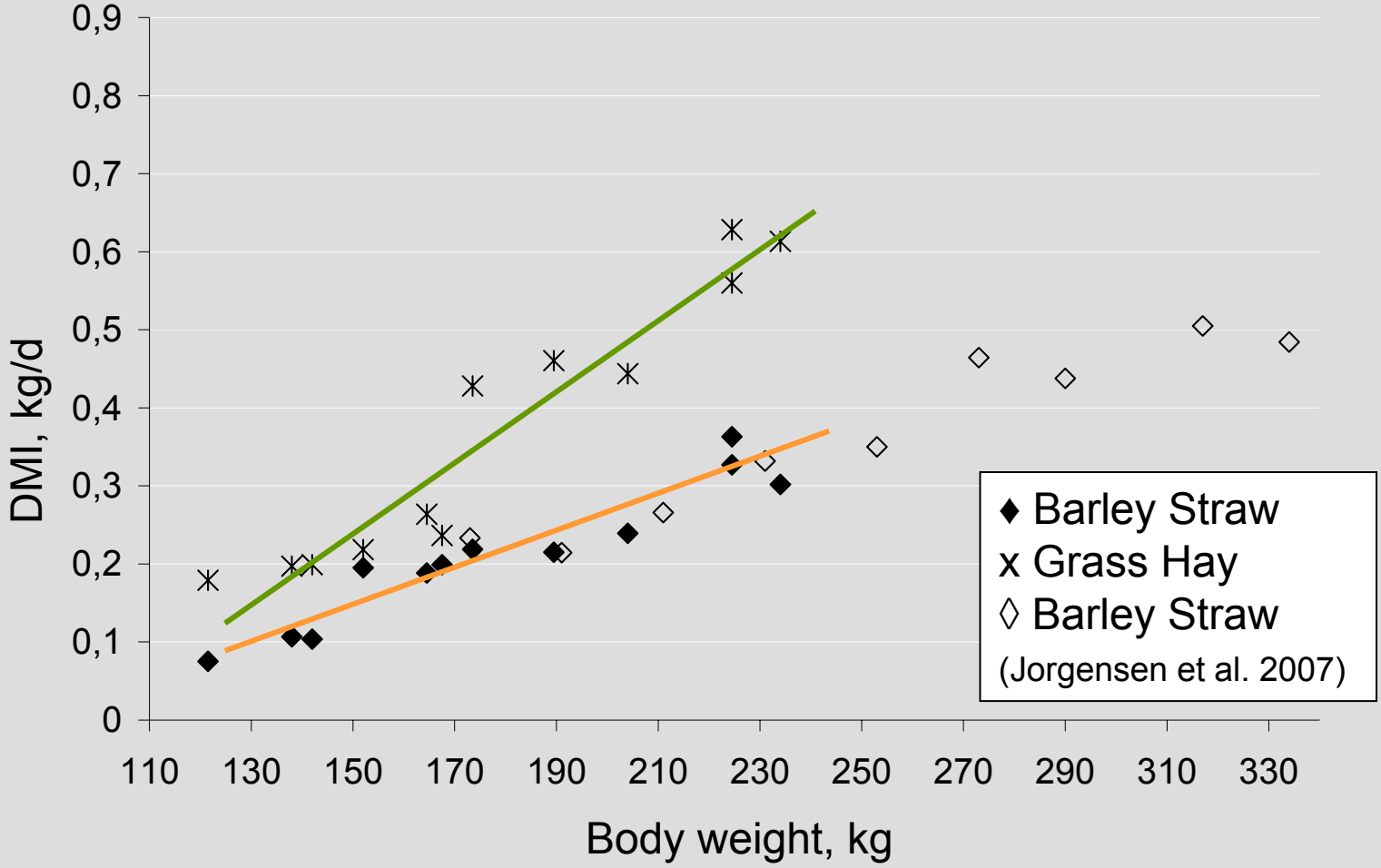
RESULTS

Across all periods, overall ADG was 1,230 ± 100 g and was not affected by treatment

Feed intake (DMI) of Grass Hay (GH) was higher than of Barley Straw (BS)

Item	Treatments			
	LS-BS	LS-GH	HS-BS	HS-GH
DMI per day				
Concentrate, kg	5.10	5.13	5.18	5.43
Roughage, kg	**0.24**	**0.42**	**0.18**	**0.33**
Total, kg	5.32	5.54	5.36	5.75

Feed intake (DMI) of Grass Hay (GH) was higher than of Barley Straw (BS)



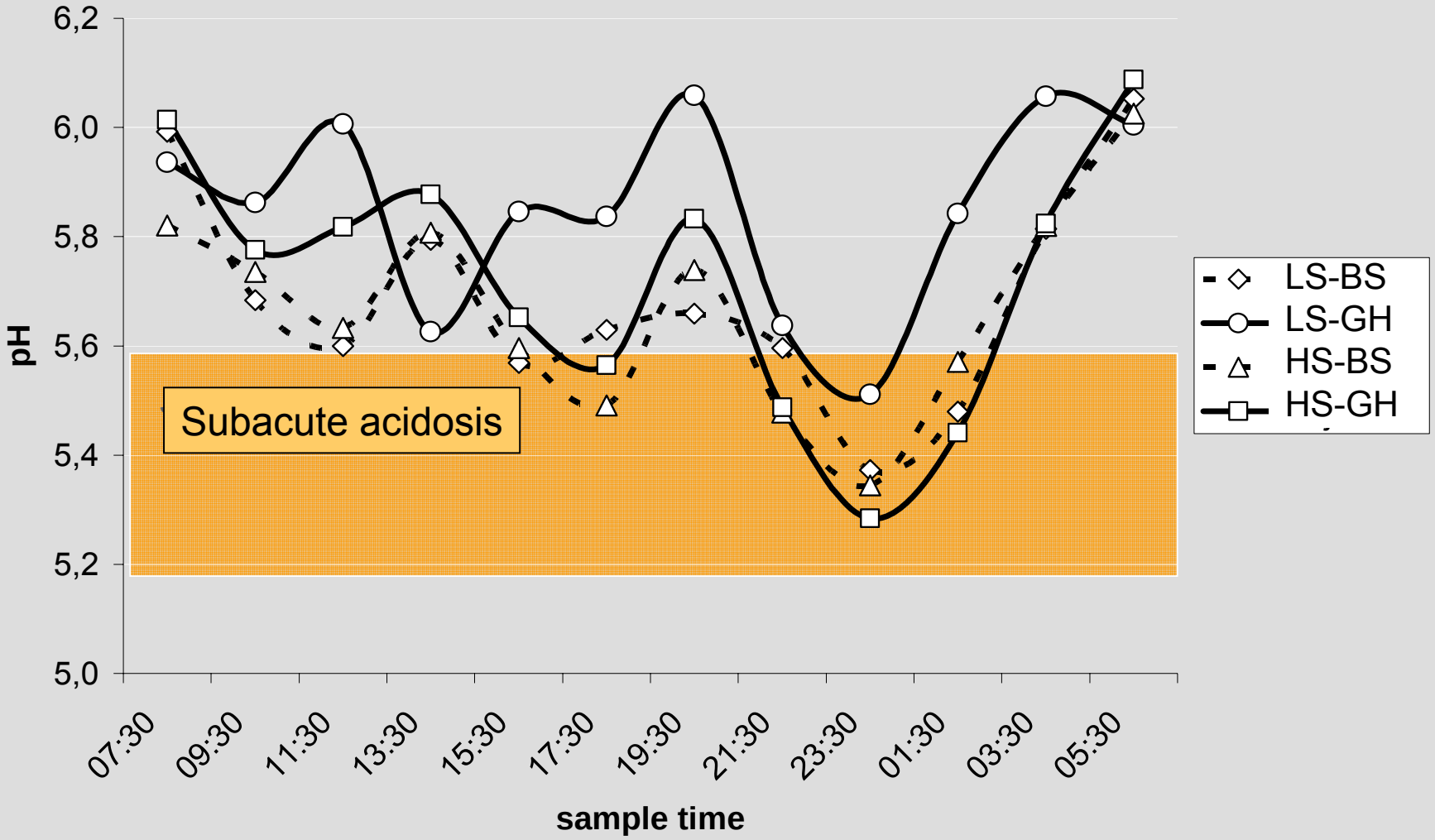
Average daily NDF and starch intake

Item	Treatments			
	LS-BS	LS-GH	HS-BS	HS-GH
DMI/d				
NDF, gram/d	**1203**	**1240**	**877**	**946**
NDF rough, gram/d	200	224	150	178
Starch, gram/d	**1427**	**1433**	**2093**	**2177**

GH *vs.* BS increased ruminal pH and decreased hours/d with pH < 5.8

Item	Treatment			
	LS-BS	LS-GH	HS-BS	HS-GH
Average pH[3]	**5.69**	**5.85**	**5.67**	**5.72**
Hours/d with pH<5.8	**16.9**	**12.4**	**17.1**	**13.6**
Hours/d with pH<5.6	12.0	8.0	11.7	11.3
Minimum pH*	5.32[a]	5.36[a]	5.28[a]	5.20[b]

GH *vs.* BS increased ruminal pH and decreased hours/d with pH < 5.8



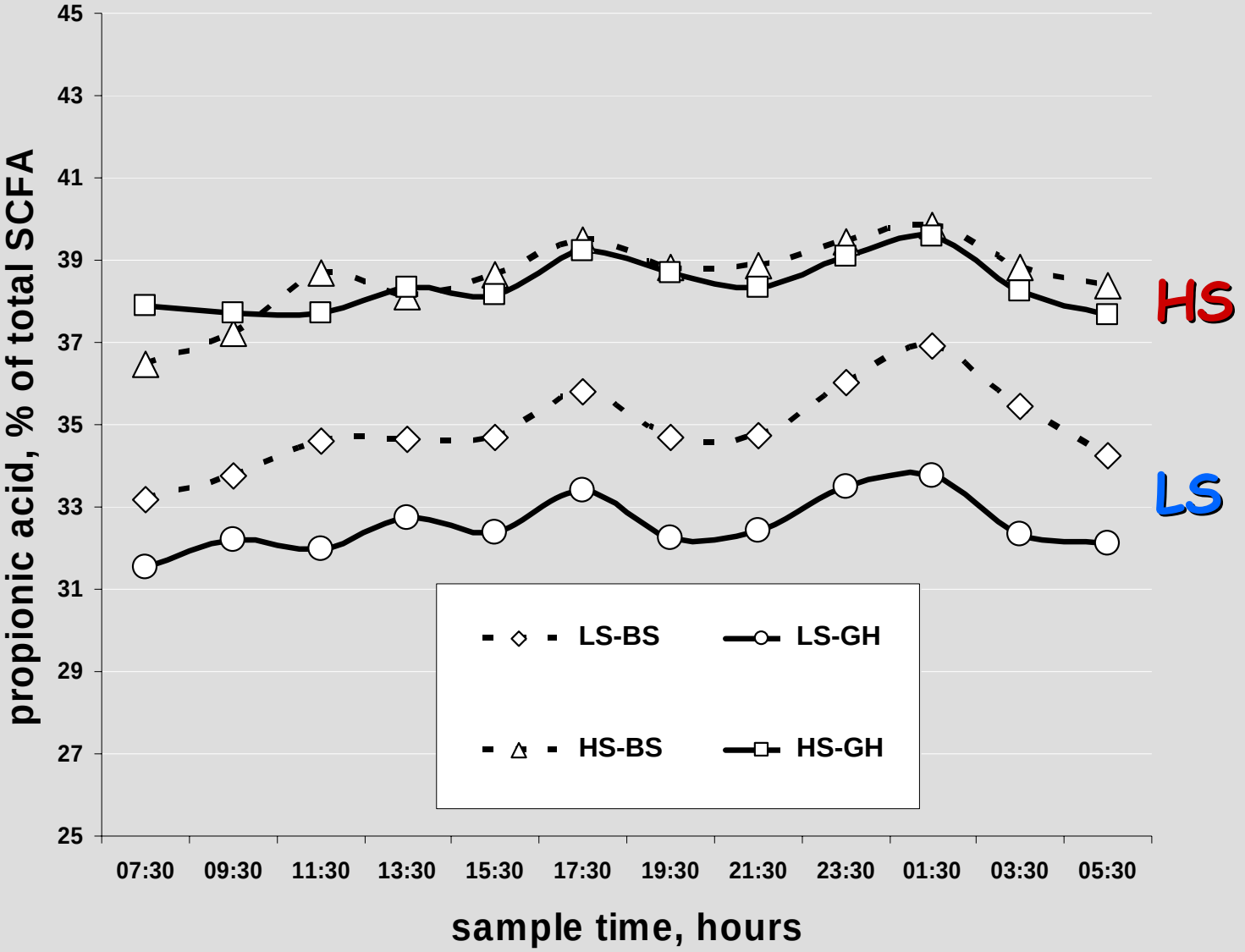
LS *vs.* HS concentrate only tended to increase ruminal pH

(5.77 vs. 5.70, $P < 0.10$)

The proportion of C2 and C4 was higher and that of C3 lower with LS *vs.* HS concentrate

	Treatment			
Item	LS-BS	LS-GH	HS-BS	HS-GH
Total VFA, m*M*	148	148	156	155
VFA, percentage	Total VFA was high compared with dairy cows !			
Acetate	53.0	55.0	50.4	49.4
Propionate	34.9	32.6	38.6	38.4
Butyrate	8.3	8.6	7.4	7.7

Propionic acid (C3) proportion of VFA in rumen fluid over a 24 h period

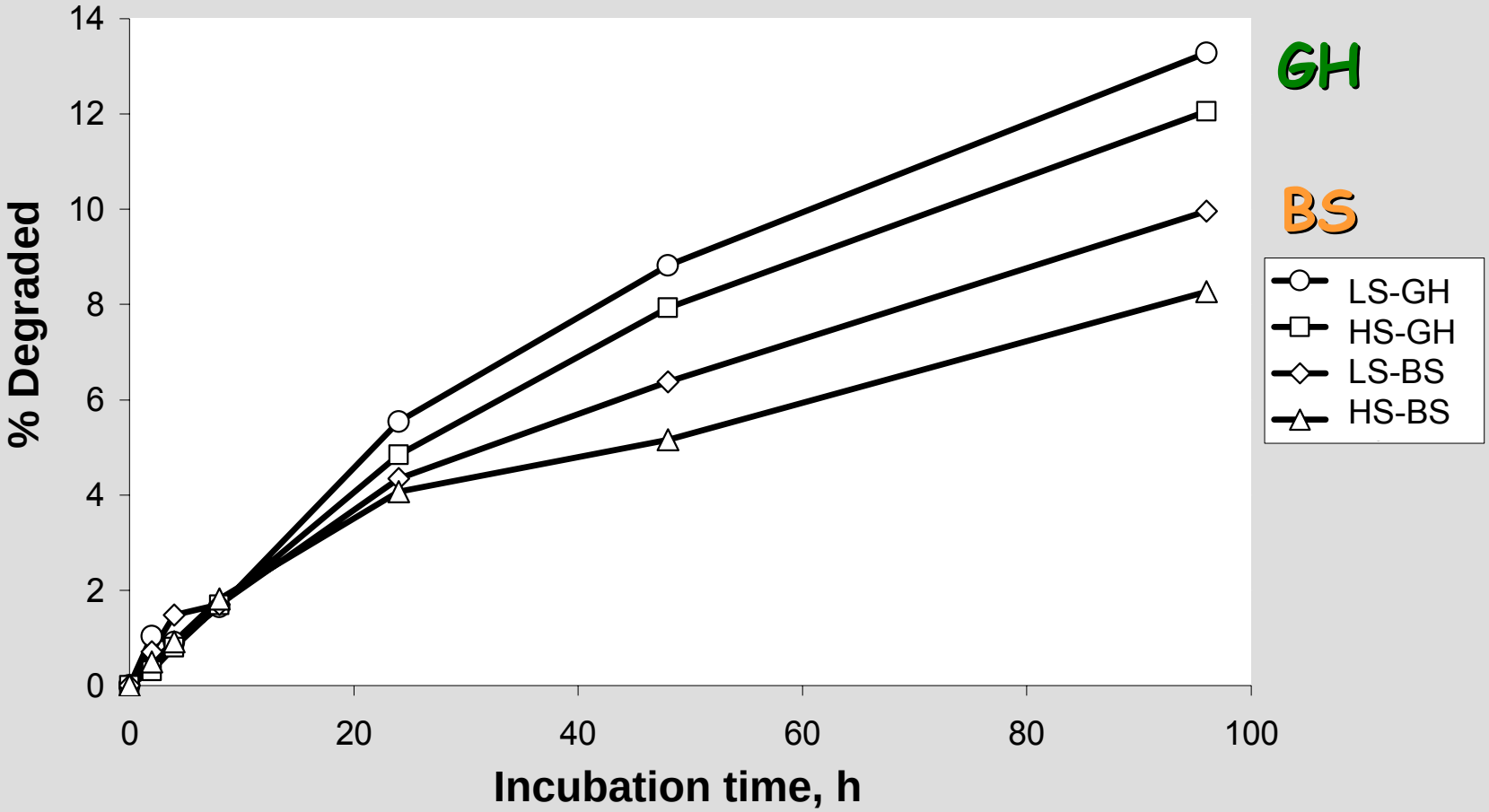


Total VFA conc. and content of individual VFA (C2, C3 and C4) was unaffected by roughage type

Rumination

- Time spent ruminating was 235 ± 28 min/d and 48 ± 10 min/kg DM with no effect of treatment

Feeding GH *vs.* BS improved *in sacco* NDF degradation of barley straw and grass hay



Feeding LS *vs.* HS concentrate improved *in sacco* NDF degradation of barley straw

Conclusion

- Changing the **concentrate** composition towards 33% more cell-walls and 33% less starch:
  - Increased rumen pH less than expected
  - Increased C3 and reduced C2 and C4 (VFA)
- Feeding **grass hay** ***vs.*** **straw** will improve NDF degradation of roughages
- **Giving intensively-fed bull calves access to grass hay instead of barley straw will improve the rumen environment**