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The effect of preservation method of barley, maturity of grass silage, and type of protein supplement on sensory milk quality in organic farming

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ABSTRACT

Six experiments were carried out in Northern Norway to investigate different feeding strategies for dairy cows in organic farming. Different preservation methods for barley, different maturity of grass silage, and different protein supplements had no effect on the sensory quality of milk. Fish meal gave no deviation from normal milk flavour even when it was given 2 h or 1/2 h before evening milking.

KEY WORDS: sensory quality, dairy, organic farming, cereals, grass silage, protein supplement

INTRODUCTION

Marginal climatic conditions in Northern Norway challenge organic farmers in producing feeds rich in energy and protein. Different strategies to increase the concentration of nutrients in concentrates and grass silage were tested in feeding experiments. Marine fish products are valuable protein feeds, but their content of fish oil (Lacasse et al., 2002) and degradation products of fat and protein may reduce the taste of milk. Common dairy feeds that transmit taste and odour, which may be characteristic of the feed when fed 2 to 4 h before milking, can be fed immediately after milking without producing a feed flavour in the milk (Shipe et al., 1978). Volatile flavour components may be detected in milk and cause taint shortly after feeding, and Norwegian experience and practice is that feed taint is avoided by feeding after, rather than before milking. This paper focuses on sensory milk quality in six experiments with organic farming.

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MATERIAL AND METHODS

Three continuous production experiments (P1, P2, P3) and three short term cross over experiments (C1, C2, C3; 3 periods of respectively 7, 11, 5 days) were carried out with Norwegian Red cattle in Bodø (Norway; 67° 17' N, 14° 23' E) during winter seasons between 2003 and 2006 (Table 1). Half of the 32 cows in the production experiments were fed 40% (HC) concentrates (on energy basis per year) and the other half 10% (LC). Twelve cows (HC) participated in the short term cross over experiments, which had a special focus on sensory milk quality.

Table 1. Continuous production experiments and short term cross over experiments

	Year	Experimental factor	Treatments (HC: 40% concentrates per year, NEL[1]; LC: 10%)		
			1 (HC and LC)	2 (HC and LC)	
P1	2003-04	Barley preservation	Dried	Ensiled with molasses	
P2	2004-05	Silage maturity	Timothy axes perceptible	Timothy axes visible	
P3	2005-06	Protein supplement	Fish meal[2]	Pea meal	
			1 (HC)	2 (HC)	3 (HC)
C1	2004	Barley preservation	Dried	Ensiled, molasses	Ensiled, acid[3]
C2	2005	Protein supplement	Fish meal[2]	Fish protein conc[4]	Pea meal
C3	2006	Time for fish meal[2]	2 h before evening milking	1/2 h before	After

[1] NEL: net energy lactation

[2] NorsECO, Norsildmel, Egersund (Norway), codfish, crude protein (CP) average 642 g/kg dry matter (DM), ether extract (EE) average 54 g/kg DM

[3] Eng-silage 2000, Agil ltd. Hercules; Freyasdal Norsk kjemi AS, ammonium salts 555 g/kg, propionic acid 200 g/kg, formic acid 10 g/kg

[4] Scanbio, Bjugn (Norway), pelagic fish species, CP 678 g/kg DM, EE 76 g/kg DM

In all experiments the cows were offered grass silage *ad libitum*, restricted amounts of cereals and protein feeds, and mineral and vitamin supplements. All grass silages were well preserved and their energy and protein concentrations in the production experiments are presented in Table 2. The grass silages used in the cross over experiments had slightly lower concentrations than in the production experiments (in C2 grass silage harvested at normal time was used).

Trained panels (Tine Dairies Bodø and the Norwegian Institute for Food and Environmental Analysis, Oslo) evaluated the sensory quality of raw milk. Aliquot samples of morning and evening milk were collected once in the preliminary period as a covariate and twice in the experimental period (P1, P2, P3), or in the end of each period of C1 and C2. In C3 only evening milk was used. Tine Dairies Harstad, Norway scanned (CombiFoss™ 5000, Foss, Denmark) milk samples weekly to measure concentrations of fat and protein.

Table 2. Composition of grass silage in the continuous production experiments

n = 3, 5, 4	P1		P2				P3	
	average	SD	early	normal	SEM	P	average	SD
NEL, MJ[1]	5.55	0.240	6.42	5.69	0.072	<0.001	5.69[2]	0.214
CP[3], g/kg DM	112	10.3	138	108	3.9	<0.001	133	10.2

[1] NEL: net energy lactation analysed by Near Infra Red Spectroscopy (NIRS); [2] analysed in grass; [3] CP: crude protein; abbreviations see Table 1

RESULTS

Feed intake, milk yield, and milk composition in the production experiments are presented in Table 3. The sensory quality of milk was in general high (Table 4). In the production experiments, milk from cows in HC had slightly better quality than from cows in LC (significant in P2, HC: 4.2; LC: 3.9; P=0.04). Neither the preservation method of barley, maturity of grass silage nor type of protein supplement influenced the sensory milk quality significantly (Table 4).

Also in the cross over experiments no effect of the studied factors was found in milk flavour.

Table 3. Feed intake and yield in the continuous production experiments

	P1				P2				P3			
	dried	ensiled	SEM	P	early	normal	SEM	P	fish meal	pea meal	SEM	P
Grass silage intake, kg DM												
HC	12.8	12.7	0.91	0.94	16.9	14.4	0.65	0.02	13.2	13.0	0.79	0.89
LC	14.8	15.7	0.85	0.48	16.5	15.2	0.65	0.17	13.8	13.6	0.56	0.85
Cereals intake, kg DM												
HC	5.51	5.56			2.81[1]	4.40			3.73	1.45		
LC	1.00	1.00			1.02	1.05			2.22	0.85		
Protein feed intake, kg DM (P2 fish meal; P3 fish meal and pea meal)												
HC					0.92	0.93			0.676	2.90		
LC					0.92	0.94			0.397	1.69		
Yield, kg												
HC	20.3	19.6	0.50	0.39	26.3	23.9	0.84	0.07	23.2	21.7	0.44	0.03
LC	17.2	17.4	0.56	0.78	23.3	21.4	0.79	0.11	20.1	18.9	0.37	0.04
Fat, g/kg												
HC	47.4	46.3	0.48	0.15	43.3	44.5	0.92	0.36	40.0	43.0	0.65	0.01
LC	44.3	43.5	1.43	0.70	45.0	44.9	1.04	0.92	41.2	41.5	0.76	0.75
Protein, g/kg												
HC	32.0	31.9	0.34	0.72	34.6	32.8	0.52	0.03	32.3	32.2	0.41	0.80
LC	29.3	28.9	0.67	0.64	34.4	31.4	0.52	0.002	30.7	31.1	0.28	0.33

[1] differences between early and normal due to concentrate leftovers, respectively 1.91 and 0.30 abbreviations see Table 1

Table 4. Milk flavour score

	P1				P2				P3			
	dried	ensiled	SEM	P	early	normal	SEM	P	fish meal	pea meal	SEM	P
HC	1.06	1.00	0.044	0.33	4.28	4.19	0.160	0.70	4.25	4.01	0.127	0.20
LC	1.10	1.09	0.066	0.93	3.80	3.93	0.172	0.62	4.02	3.85	0.147	0.44

	C1					C2					C3				
	1	2	3	SEM	P	1	2	3	SEM	P	1	2	3	SEM	P
	1.00	1.04	1.00	0.024	0.39	4.20	4.12	4.21	0.138	0.87	4.13	4.33	4.17	0.093	0.29

[1]P1 and C1: three-point scale, where 1 is best; P2, P3, C2 and C3; five point scale, where 5 is the best
abbreviations see Table 1

DISCUSSION

A low feed level caused by a low concentrate level clearly reduced milk yield and milk protein concentration, and further tended to reduce the sensory milk quality. Although early cut grass silage improved feed intake, milk yield and milk protein concentration, compared with normal cut grass silage, it did not prevent a slightly reduced sensory milk quality for cows fed LC. The well-preserved quality of the marine protein supplement and its low concentration of fat may have prevented a reduction of milk sensory quality in all the four experiments where it was used, and even when it was fed 2 or 1/2 h prior to evening milking.

CONCLUSIONS

The sensory milk quality was not affected by feeding regimes comparing dried or ensiled barley, grass silage cut early or at a normal time, protein supplements consisting of fish meal, fish protein concentrate or pea meal, or fish meal fed before or after evening milking. These results indicate that organic farmers with different feeding regimes can produce milk of first class sensory quality.

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