Effect of processing of whole crop wheat silage on digestibility by cows

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Åshild T. Randby, Elisabet Nadeau, Linda Karlsson, Erik Brodshaug and Astrid Johansen

Norwegian University of Life Sciences

Background

- Whole crop wheat silage (WCWS) gives a high DM yield in one single cut
- Diets including WCWS frequently increases DM intake, but increases in production are often small or absent (Phipps et al. 1995, Sutton et al. 1998, Sinclair et al. 2003, Beck et al. 2009)
- Mature whole cereal grains are known to be poorly digested by cattle (Sutton et al. 1997)
- Whole grains at duodenum have been considered to explain low rumen digestibility (Abdallah et al. 1999)

Aim

- Determine how processing (crushing, rolling) of wheat grains in whole crop wheat silage harvested at early and hard dough stages influences digestibility by cows

Hypotheses

1. Total tract OM and starch digestibility increases by grain processing
2. This increase is greater when harvesting at the hard dough stage (Zadoks 87) than at the early dough (Zadoks 83)

Methods – wheat growing

Spring wheat, var. Krabat, was sown in Ås, Norway, 20. april 2015.

Photo 16. June

Methods – harvesting

A half of the field was harvested at early dough, Zadoks 83, 27. July

Methods - harvesting

The second half was harvested at the soft-to-hard dough, at Zadoks 86, 14. August

Zadoks et al. 1974:
A decimal code for the growth stages of cereals

Zadoks code from 0 to 99:

Dough development			
80	-		
81	-		
82	-		
83	Early dough	–	Our **early dough**
84	-		
85	Soft dough		
86	-	–	Our **soft-to-hard dough**
87	Hard dough		
88	-		
89	-		
Ripening			
90	-		

Methods - harvesting

The crop was mown as gently as possible to avoid kernel loss, and picked up without wilting ……

Methods – harvesting

… by driving Orkel hiQ smartbaler in the opposite direction to the mower.

Methods - chopping prior to feeding

Bales were chopped using Kverneland Silo King TMR mixer for 40 minutes, to approximately 3 cm median chop length

Methods - processing

Half of the silage from each maturity stage was processed using Murska 350 S roller mill

Experimental design

Eight cows were allocated to two 4 × 4 Latin Squares, each with 4 cows and 4 three-week periods.

Four dietary treatments, A to D, consisted of whole crop wheat silage from the two maturity stages either unprocessed or processed:

Cow Per	5840	5830	6033	5864
1	A	B	C	D
2	D	C	A	B
3	C	D	B	A
4	B	A	D	C

Cow Per	6044	6023	5946	5725
1	A	B	C	D
2	D	A	B	C
3	B	C	D	A
4	C	D	A	B

Dairy cow diets

Wheat silage sprayed with 50 g/d of water soluted urea was offered *ad libitum* as the sole roughage.

Cows were supplemented with 6.6 kg DM/d of concentrates, and a supplement containing $NaHCO_3$.

Feed residues were kept low (4.8%) in order to minimize feed selection.

Digestibility

Urine and faeces were collected during the last four days in each period.

Total tract apparent digestibility of total diet was determined.

Composition of whole crop wheat silage

	Early dough		Soft-to-hard dough	
	Un-proc.	Processed	Un proc.	Processed
DM, g/kg	335	332	422	423
pH	4.37	4.33	4.71	4.71
NH_3-N, g/kg N	154	155	118	115
INDF, g/kg NDF	376	378	425	437
g/kg DM				
OM	949	945	957	957
Protein	104	102	100	105
NDF	480	484	454	458
Starch	110	109	266	241
WSC	97	95	49	48
Acids + ethanol	91	96	58	60

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Total diet daily intake

	Early dough		Soft-to-hard dough			*P-value*		
	Un-proc-essed	Proc-essed	Un-proc-essed	Proc-essed	SEM	Maturity	Pro-cessing	Inter-action
DM, kg	20.4	20.9	21.0	21.5	0.389	<0.001	<0.001	NS
OM, kg	19.1	19.5	19.8	20.2	0.375	<0.001	<0.001	NS
N, kg	0.51	0.51	0.51	0.53	0.008	<0.001	<0.001	<0.001
NDF, kg	7.61	7.87	7.54	7.77	0.175	0.07	<0.001	NS
Starch, kg	3.47	3.51	5.75	5.49	0.085	<0.001	<0.001	<0.001
WSC, kg	1.83	1.84	1.21	1.21	0.029	<0.001	NS	NS

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Total tract apparent digestibility of total diet

	Early dough		Soft-to-hard dough			*P-value*		
	Un-proc-essed	Proc-essed	Un-proc-essed	Proc-essed	SEM	Maturity	Pro-cessing	Inter-action
DM	0.673	0.671	0.665	0.655	0.0046	0.01	NS	NS
OM	0.690	0.689	0.678	0.669	0.0046	0.002	NS	NS
N	0.724	0.716	0.722	0.720	0.0057	NS	NS	NS
NDF	0.477	0.490	0.428	0.424	0.0091	<0.001	NS	NS
Starch	0.981	0.982	0.986	0.984	0.0010	0.002	NS	0.05
WSC	0.993	0.994	0.988	0.987	0.0009	<0.001	NS	NS

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WSC	0.993	0.994	0.988	0.987	0.0009	<0.001	NS	NS

What about the hypotheses?

1. ~~Total tract OM and starch digestibility increases by grain processing~~
2. ~~This increase is greater when harvesting at the hard dough stage (Zadoks 87) than at the early dough (Zadoks 83)~~

Digestibility of whole crop wheat silage was not influenced by processing, neither at early dough, nor at soft-to-hard dough.

Effect on intake

Processing with Murska roller decreased particle length at both maturity stages, which is the probable reason for increased intake of processed wheat silage.

Increasing intake with advancing maturity of whole crop silage was in line with calculated Silage Dry Matter Intake Indexes (Huhtanen et al. 2007).

Maturity, DM and processing

Previous publications with wheat harvested at dough stages have partly been from later stages (hard dough, Zadoks 87) or at higher DM concentrations (600 g DM/kg; Abdallah et al. 1999.

Maturity stage and DM concentration may both influence digestibility of whole wheat kernels by cows.

This study does not move the fact that dry, mature, whole grain are poorer digested by cattle than rolled or milled grain (Sutton et al. 1997)

Conclusion

Starch in wheat kernels harvested at the soft-to-hard dough stage, at Zadoks 86, or earlier, at a DM concentration up to 430 g/kg, is completely digested in dairy cows without any processing.

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