Proteolysis in TMR silages formulated with fresh or fermented ingredients

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Introduction Ensiling TMR is not a recent practice, nevertheless the benefits associated with this technique (e.g. incorporation of wet by products to the ration, high aerobic stability, uniform composition during storage) have been increasing the interest of industry and farmers in Brazil. A current practice adopted by the industry to produce TMR silages is the incorporation of fermented feeds (e.g. corn silage; high moisture corn), which could curtail proteolysis during TMR fermentation once most enzymes has lower activity under acidic pH. The aim of this research was to evaluate the N fractionation of ensiled TMR formulated for lactating dairy cows and finishing beef cattle containing fresh or fermented ingredients.

Material and methods Two TMR were formulated to meet the requirements of lactating dairy cows (600 kg BW; 30 kg/d of milk yield; NRC Dairy Cattle, 2001) or finishing beef cattle (440 kg of average shrunk BW; 1.5 kg/d of average daily gain; NRC Beef Cattle, 2016). Dairy TMR (16% CP; 25% forage NDF) contained (DM basis) fresh chopped whole plant corn (50%), ground corn (16.4%), wheat bran (15%), soybean meal (15.6%), limestone (0.87%) and vitamin-mineral mix (2%). Beef TMR (13% CP; 10% forage NDF) was composed (DM basis) of fresh whole plant corn (20%), ground corn (56.4%), wheat bran (20%), urea (1.09%), limestone (0.73%) and vitamin-mineral mix (2%). Water was added onto the mixture to adjust moisture content (50% DM). Both TMR were ensiled in vacuum-sealed bags (1.2 kg each; 4 bags per treatment). Simultaneously, fresh chopped whole plant corn and concentrate mix (rehydrated to 35% moisture) were ensiled and a portion of dry concentrate mixtures were also stored. After 65 d of storage, the silos were opened, and a second set of silos was produced (re-ensiled) using corn silage as forage source and dry or fermented concentrate mixtures. In beef re-ensiled TMR, water was added to adjust DM to 50%. The second set of silos was also stored for 65 d. Samples were taken to prepare an aqueous extract (25 g of sample + 225 mL of distilled water) for analysis of ammonia. Another sub-sample were dried (55°C during 72 h) and ground (1 mm) for analysis of CP, buffer soluble N, neutral detergent insoluble nitrogen and acid detergent insoluble nitrogen, using the Kjeldahl method. Nitrogen fractionation, rumen degraded protein (RDP) and rumen undegraded protein (RUP) were calculated according to CNCPS v6.5. Data were analyzed using the MIXED procedure of SAS and means compared by orthogonal contrasts.

Results and discussion Ensiling beef TMR (ETMR vs FTMR) increased ammonia (A1) by 100%. However, ensiling the beef TMR containing fermented corn silage and dry concentrates (RETMR) led to lower A1 fraction than that composed of fresh ingredients (ETMR) (-29%) or fermented concentrates (RETMRFC) (-45%). The A2 fraction (soluble true protein) increased in ETMR compared with FTMR (+42%) and in RETMR compared with ETMR (+11%), whereas decreased in RETMRFC compared with RETMR (-18%). The opposite pattern was observed for B1 fraction

(insoluble true protein). For dairy rations, ETMR also had higher values of A1 and A2 compared with FTMR (by +1005% and +186%), as well as and RETMR had more A1 and A2 than ETMR (by +182% and +15%). No differences were observed between RETMR and RETMRFC for A1 and A2 fractions. The B1 fraction was also higher in ETMR compared to RETMR (by +20%), as well as in RETMRFC compared to RETMR (by +5%). Overall, using fermented concentrate as ingredient slightly reduced proteolysis in both beef and dairy TMR silages (see A2 and B1 fractions), whereas increased deamination in beef but not in dairy TMR silage. Meanwhile, ensiling beef or dairy TMR increased RDP or decreased RUP compared with a TMR containing all fresh ingredients, but only by 6% (on average), regardless the use of fresh or fermented ingredients.

Table 1 Nitrogen fractionation in TMR silages containing fresh or fermented ingredients for lactating dairy cows or finishing beef cattle (g/kg of total N)

Item[a]	Total mixed ration[b]				SEM	P-contrast[c]		
	FTMR	ETMR	RETMR	RETMRFC		F×E	E×RE	RE×REFC
Dairy TMR								
A1	0.95	10.5	29.6	29.5	3.24	<0.01	<0.01	0.96
A2	145	415	479	464	35.1	<0.01	<0.01	0.11
B1	636	483	403	423	23.8	<0.01	<0.01	0.04
B2	138	55.4	46.1	36.3	10.61	<0.01	0.08	0.07
C	78.2	35.3	41.4	46.7	4.44	<0.01	0.12	0.17
RDP[d]	649	691	691	689	4.7	<0.01	0.91	0.42
RUP[e]	351	309	309	311	4.7	<0.01	0.91	0.42
Beef TMR								
A1	40.9	81.9	57.9	105	6.69	<0.01	<0.01	<0.01
A2	403	572	636	525	22.4	<0.01	<0.01	<0.01
B1	391	280	246	306	14.7	<0.01	0.03	<0.01
B2	103	37.4	36.4	31.8	7.84	<0.01	0.85	0.38
C	60.2	28.6	23.9	31.1	3.74	<0.01	0.06	<0.01
RDP	715	757	756	758	4.8	<0.01	0.83	0.42
RUP	285	243	244	242	4.8	<0.01	0.83	0.42

[a]Nitrogen fractionation according to CNCPS v6.5; [b]FTMR: fresh TMR containing fresh chopped whole plant corn and dry concentrates, ETMR: ensiled TMR containing fresh chopped whole plant corn and dry concentrates, RETMR: ensiled TMR containing corn silage and dry concentrates, RETMRFC: ensiled TMR containing corn silage and fermented concentrates; [c]Contrasts: Fresh vs Ensiled (F × E), Ensiled vs Re-ensiled (E × RE) and Re-ensiled with dry concentrate vs Re-ensiled with fermented concentrate (RE × REFC); [d]RDP: Rumen degraded protein (g/kg CP); [e]RUP: Rumen undegraded protein (g/kg CP).

Conclusions Compared with a TMR containing all fresh ingredients, ensiling beef or dairy TMR increased RDP or decreased RUP only by 6%, regardless of the use of fresh or fermented ingredients.