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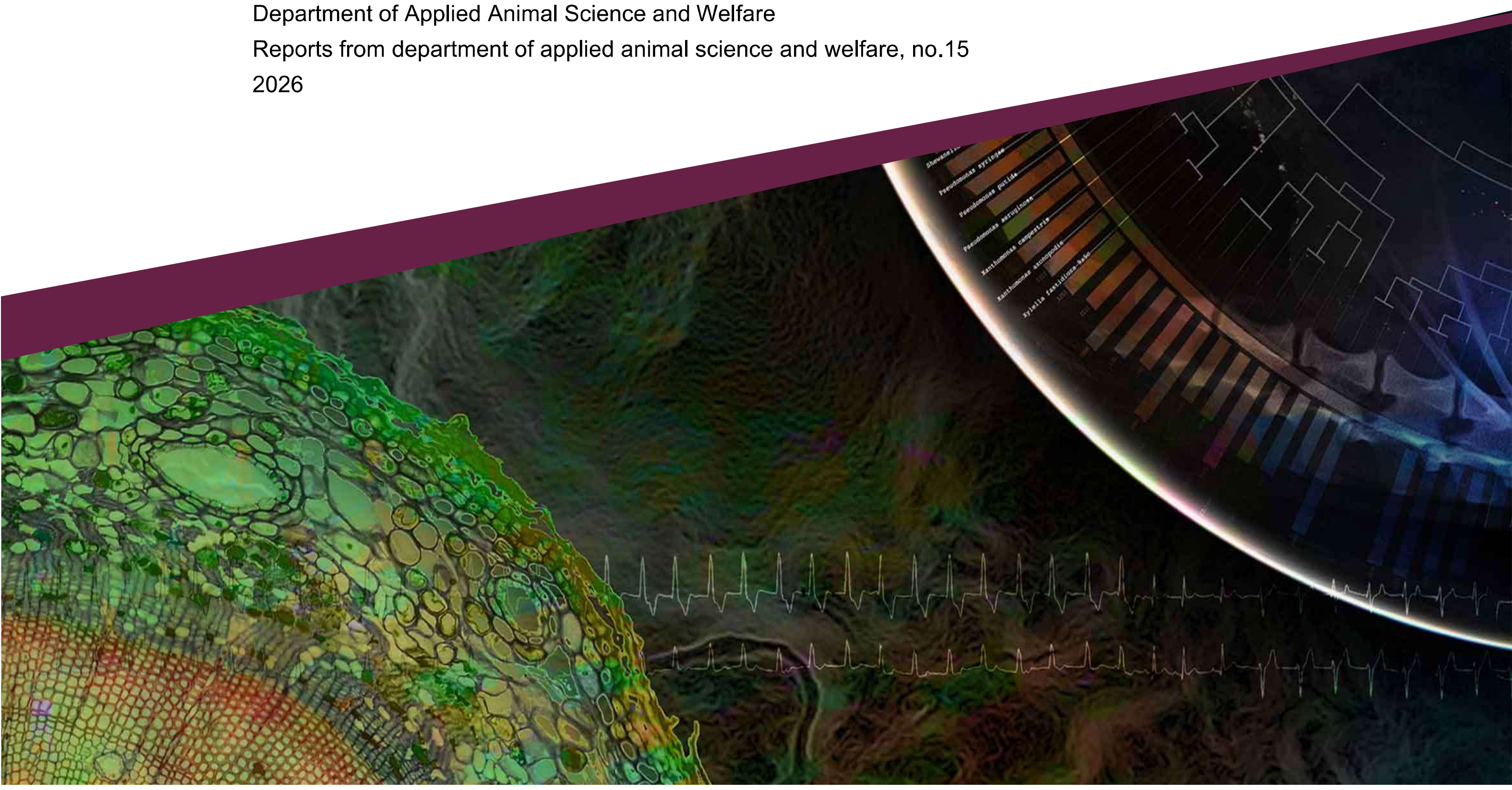

Update of NorFor values for beets and beet silages.

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Introduction

Beet (*Beta vulgaris*) can be fed to dairy cows either as-is or ensiled, with ensiling extending the feeding season and shifting the composition from sugar-rich to ethanol-rich material (Hvas et al., 2025a). The introduction of new beet varieties and the development of modern ensiling methods create a need to update the beet and beet-silage table values in the Nordic Feed Evaluation System (NorFor) to reflect current varieties and practices.

Materials and Methods

Recent Danish research data on beets and beet silages were compiled to update the NorFor Feed Table with values for beets and beets silages. For as-is beets, two dry matter (DM) levels were included (16.5% and 23%). Compositional data were based on 57 samples of dry-cleaned beets (21 samples at 16.5% DM and 36 samples at 23% DM; Hvas et al., unpublished). Data on organic matter digestibility (OMD) were derived from seven washed samples of beets within each DM level (Hartnell et al., 2005), with one additional dry-cleaned sample included for the 23% DM group (Hvas et al., 2025b).

Beet silage data represent three ensiling strategies: the top-layer method, pure beet silage, and the mixing method. Top-layer silages were sampled from three silos on two commercial farms where beets were ensiled on-top of existing maize or grass/clover silage, and samples were collected at one-third and two-thirds of the beet layer, yielding six samples in total. Data on pure beet silage were based on 16 samples, including three replicates of washed beets ensiled in barrels (Hvas et al., 2025a) and 12 replicates ensiled in pallet tanks (Hellwing et al., 2017), and one also ensiled in pallet tank (Olijhoek et al., 2023) but excluded from ash calculations due to unusually high ash content despite washing. For the mixing method, beets were co-ensiled with grass–clover silage in bales at a ration of 37.5:62.5 on a DM basis (beets:grass-clover silage), represented by four replicates (Hvas et al., 2025b).

Relevant analytical parameters used in NorFor, including DM, sugar, and lactate, were extracted when available. For top-layer silages, selected parameters were analysed directly (Hvas et al., 2025b), and simple mean values were calculated across studies. For datasets reporting only L-lactate, total lactate was estimated as twice the reported L-lactate concentration (Johansen et al., 2020).

Results and Discussion

For as-is beets, two types were included that reflected the variation in DM typically found in practice. The high-DM type represented newer beet varieties like those used for sugar production, whereas the low-DM type was more representative of older fodder beet varieties (Evans and Messerschmidt, 2017). Consistent with these varietal differences, high-DM beets had slightly higher sugar concentrations and lower ash concentrations than low-DM beets.

Beets used for pure beet silage were washed before ensiling, whereas the beets used in the remaining silages were only dry-cleaned, contributing to variation in ash content. In general, soil type and the level of cleaning prior to ensiling or feeding as-is have a major impact on ash concentration, and this must therefore be considered when using table values or deciding on chemical analysis.

Table 1 Chemical composition of fresh beets and different types of beet silages used as input for updating NorFor table values. Values represent mean concentrations (g/kg DM unless otherwise stated) based on available samples across studies and on-farm silages.

Item	Beets (16.5 % DM)	Beets (23 % DM)	Ensiled beets (top-layer)	Ensiled beets (barrel/tank)	Ensiled beets (mixed with grass/clover silage)
Dry matter g/kg	165[1]	230[3]	230[5]	206[6]	269[9]
Ash	97.2[1]	55.0[3]	132[5]	40.5[7]	117[9]
Crude protein	53.0[1]	36.0[3]	52.2[5]	58[6]	115[9]
NH_3-N, g N/kg N	-	-	-	53.3[8]	786[9]
NDF	108[1]	90.8[3]	146[5]	146[6]	357[9]
Starch	-	-	-	ND	3.99[9]
Lactate	-	-	45.5[5]	46.9[6]	76.6[9]
Acetate	-	-	56.6[5]	29.7[6]	19.3[9]
Propionate	-	-	1.29[5]	2.04[6]	0.61[9]
Butyrate	-	-	ND	ND	0.16[9]
Alcohols	-	-	94.7[5]	108[6]	112[9]
Sugars	681[1]	771[3]	38.7[5]	123[8]	38.4[9]
Pectins	62.1[1]	53.2[3]	-	-	-
OMD, % of OM	90.7[2]	93.3[4]	-	-	75.5[9]

ND = value below lower limit of detection.
- = Not analysed.
[1]Hvas et al. (Unpublished); n = 21
[2]Hartnell et al. (2005); n = 7
[3]Hvas et al. (Unpublished); n = 36
[4]Hartnell et al. (2005), Hvas et al. (2025b); n = 8
[5]On-farm samples; n = 6
[6]Hvas et al. (2025a), Hellwing et al. (2017), Olijhoek et al. (2023); n = 16
[7]Hvas et al. (2025a), Hellwing et al. (2017); n = 15
[8]Hvas et al. (2025a), Olijhoek et al. (2023); n = 4
[9]Hvas et al. (2025b); n = 4

It is therefore recommended that beet ash content is analysed prior to ensiling. A slight increase in ash concentration during ensiling is expected, as DM losses occur through fermentation, particularly when sugars are fermented by yeasts with substantial CO_2 losses (Borreani et al., 2018). Consequently, when standard table values are used for nutrients, including fermentation products, concentrations should be adjusted to the actual ash content of the beets or silage by applying an organic matter (OM) correction. The adjustment factor, used to scale table values to measured ash, is calculated as: Adjustment factor = (1000 – table value ash content (g/kg DM)) / (1000 – measured ash content (g/kg DM). All nutrients within the OM fraction of beets and silages can then be adjusted to the actual ash content by multiplying by this factor. E.g., adjusting pure beet silage to the ash content of top-layer beet silage: (1000 – 132) / (1000 – 40.5) = 0.90. As full silage analyses, including ethanol quantification, are costly for farmers, this provides a practical compromise using measured ash values to improve NorFor inputs when full analyses are not feasible.

In addition, a considerable part of the DM in ensiled beets remains unexplained. Although mannitol formation (Hvas et al., 2025a; 2025b) and a potential up-concentration of pectin may explain part of this, a fraction of the DM still remains unaccounted for.

Conclusions

The results show substantial variation in nutrient composition and fermentation profiles across beet types and ensiling methods. Ash content and consequently OM proportion vary widely depending on beet variety, cleaning intensity, and ensiling approach, thus adjusted values can be needed. The proposed ash-based correction offers a practical solution for generating more accurate NorFor inputs when full silage analyses are not feasible. However, given the limited dataset, more data are needed to establish robust table values.

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