RELATIONSHIP BETWEEN NUTRITIONAL VARIABLES OF PRE- AND POST-ENSILED CORN CROPS: A META-ANALYSIS

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INTRODUCTION

The nutritional quality of corn silage is influenced by many factors, including plant maturity, cutting height, and hybrid type. Higher cutting heights can increase digestibility and total digestible nutrients without affecting fermentation quality (Aoki et al., 2013).

New technologies such as NIRS integrated into choppers allow real-time analysis of crop components during harvest, enabling better decision-making before and during the silage-making process. Working towards target quality levels based on the intended use of the silage is a necessary step in precision livestock farming.

The challenge is determining the quality that fresh forage must have to achieve the target quality after the silage process. However, little is known about the accuracy of predicting silage composition from crop data.

OBJECTIVES

This meta-analysis aims to systematically synthesize findings on the correlation and variation between the quality components of pre-ensiled and post-ensiled corn crops.

MATERIALS AND METHODS

- ✓ **Literature Search:** We reviewed studies (1985–2023) on nutritional variables of corn crops before (pre-) and after ensiling (post-).
- ✓ **Search Strategy:** Multiple search engines were used with keywords such as **fresh corn for silage**, **pre-ensiled corn**, and **ensiling process corn silage**.
- ✓ **Selection Criteria:** studies with at least one treatment measuring **DM, CP, ADF,** and **NDF** both before and after **≥60 days** of ensiling were included.
- ✓ **Data Handling:**
  - For studies with one pre-ensiled value and multiple post-ensiled values, post-values were averaged.
  - Final dataset: 42 treatments (DM (%) — n = 40; CP (%) — n = 42; ADF (%) — n = 32; NDF (%) — n = 42; Starch (STCH, %) — n = 35; Water-soluble carbohydrates (WSC, %) — n = 28; Ash (%) — n = 23)
  - **Relative Variability (VAR)** pre-ensiled value and multiple post-ensiled → Calculated as: ((post / pre) - 1) x 100.

    (Negative VAR = decrease after ensiling; positive VAR = increase).
- ✓ **Statistical Analysis:**
- ✓ Linear regression: post-ensiled (Y) vs. pre-ensiled (X).
- ✓ Software: InfoStat (Di Rienzo et al., 2020).

RESULTS AND DISCUSSIONS

The highest correlations were observed for DM and STCH. The lowest were for CP and WSC, likely due to their high lability and rapid utilization during fermentative processes.

Table 1. Relative variation (VAR; %) of each post-ensiled relative to its pre-ensiled variable (mean ± SD). R^2: coefficient of determination for estimating each post-ensiled variable (Y) as a function of the pre-ensiled variable (x), expressed as Y = intercept + (slope . x); P value <0.05 indicate statistically significant linear correlation.

Variable	VAR (%) Mean ± SD	R^2	Intercept	Slope	*P* value
DM, %	-0.74 ± 4.57	0.970	2.560	0.900	<0.0001
CP, %	11.76 ± 16.36	0.084	5.712	0.358	0.0630
ADF, %	4.81 ± 15.05	0.629	-5.282	1.240	<0.0001
NDF, %	-2.96 ± 16.58	0.613	-12.184	1.224	<0.0001
STCH, %	15.21 ± 20.81	0.954	1.597	1.057	<0.0001
WSC, %	-79.79 ± 28.01	0.014	2.366	-0.038	0.5456
Ash, %	11.29 ± 15.85	0.422	1.274	0.865	0.0008

DM and NDF showed significant negative correlations ($P < 0.05$) from pre- to post-ensiled values, indicating a decrease likely due to oxidative changes and water increase during air elimination. NDF reduction may result from degradation of hemicellulose and cellulose, while ADF remains stable (Seale et al., 1986). ADF, starch (STCH), and ash showed significant positive correlations ($P < 0.05$). ADF increased as labile NDF fractions decreased; STCH, which degrades slowly (>180 days), may improve digestibility over time (Ferraretto et al., 2018).

CONCLUSIONS

Real-Time Decision-Making: this meta-analysis emphasizes the need for real-time decisions during silage production to achieve optimal results for precision livestock farming.

Significant Correlations: strong correlations between pre- and post-ensiled values for DM, NDF, ADF, and STCH show that silage quality can be managed proactively.

Use of Technology: **t**ools like NIRS technology at harvest enable adjustments in cutting height, crop segregation, and other parameters to reach desired quality targets.

Nutritional precision: silage should be produced t meet target quality standards based on expected type and production level, prior to changes caused by the ensiling process.

Future Considerations: Upcoming analyses should account for storage duration, use of bacterial inoculants, and final packing density inside the silo.