Rumen microbiome from beef steers undergoing grain adaptation with steam-flaked corn varying bulk density

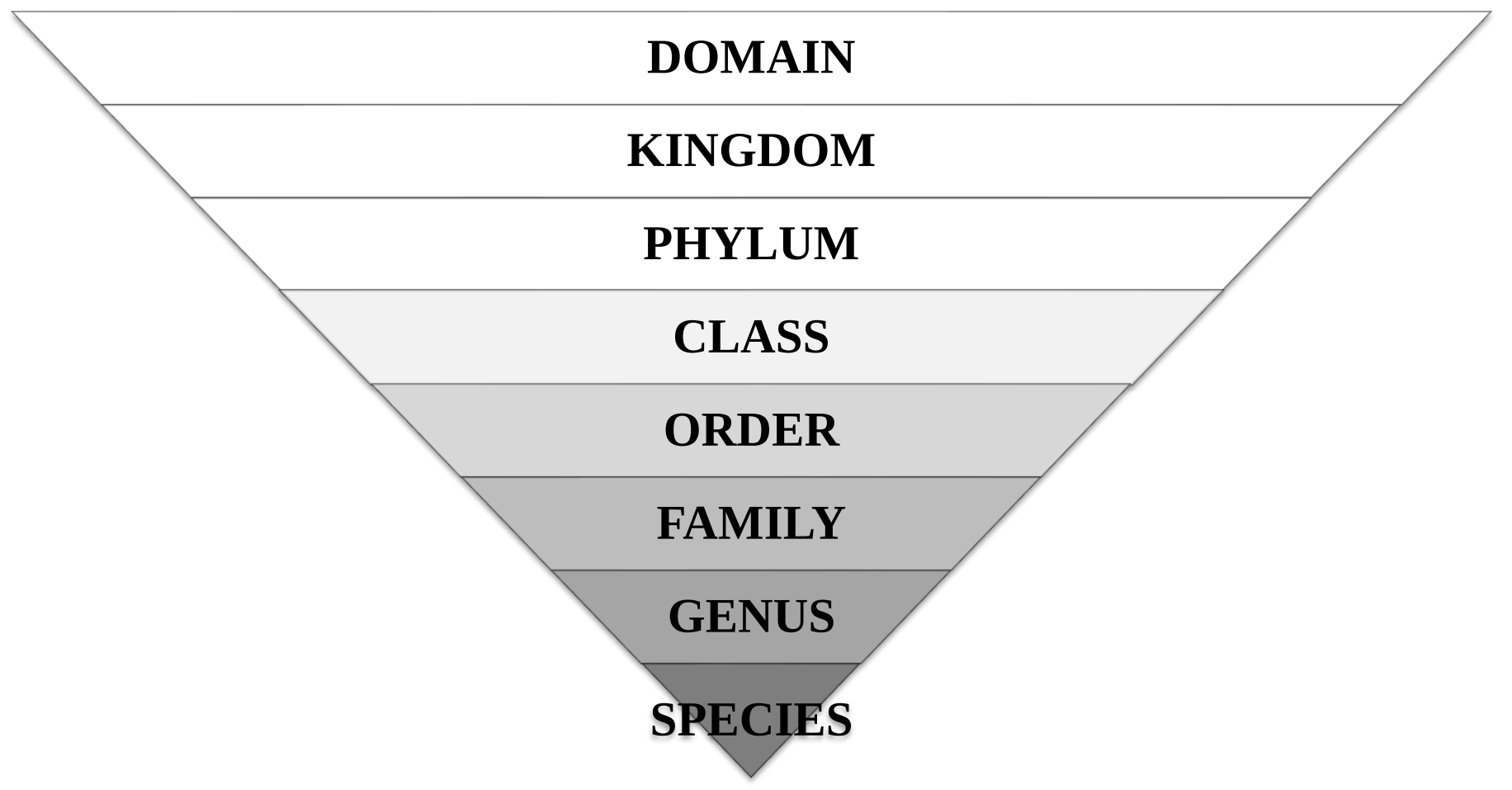
K. T. Nardi, K. G. S. Silva, I. G. Favero, J. K. Hinds, C. A. Hoffmann, S. M. Soto, D. N. Hall, D. D. Henry
and J. O. Sarturi
[1]Department of Animal and Food Sciences, Texas Tech University, Lubbock, TX-79409 contact: j.sarturi@ttu.edu

Introduction:

Steam-flaking is the most common method of grain processing used by the feedlot industry in Texas (Samuelson et al., 2016).

Proper adaptation of cattle from high forage to high concentrate finishing diets is crucial for animal growth performance and overall health (Brown et al., 2006).

The ruminal microbiota shift during such adaptation phase might be affected by substrate (specially corn) level of processing, and if so, such information can lead to the establishment of more effective adaptation strategies.



Objective:

To evaluate the effects of steam-flaked corn bulk density manipulation during the grain adaptation phase on ruminal microbiome relative abundance.

Materials & Methods:

- Ruminally cannulated crossbreed beef steers (*n* = 6; BW= 405 ±42 kg).
- Randomized complete block design (block = body weight).
- 6 adaptation phases (7 days/phase): Hay, Step 1, Step 2, Step 3, Step 4, and Finisher.
- Steam-flaked corn bulk density treatments:

335 g/L flake (26 lb/bu)
412 g/L flake (32 lb/bu)

Table 1. Dietary feed ingredient and measured nutritional composition of series of adaptation diets varying in steam-flaked corn bulk density fed to beef steers

	HAY	STEP 1	STEP 2	STEP 3	STEP 4	FINISHER
	(7d)	(7d)	(7d)	(7d)	(7d)	(7d)
Dietary Ingredient Inclusion, % DM						
Wheat, Hay	97	-	-	-	-	-
Min./vit./WCGF suppl.	3	-	-	-	-	-
SFC – 335 or 412 g/L	-	26.73	36.27	45.84	55.40	-
SFC – 335 g/L	-	-	-	-	-	64.95
Alfalfa Hay	-	30	24.5	19	13.5	8
Wet Corn Gluten Feed	-	40	35	30	25	20
Mineral/vitamin supplement[1]	-	2	2	2	2	2
Tallow	-	0.5	1.13	1.75	2.38	3
Limestone	-	0.60	0.83	1.05	1.28	1.5
Urea	-	0.17	0.27	0.36	0.46	0.55
Calculated nutrient composition, % DM basis						
NEm[2], Mcal/kg	0.77	1.84	1.92	2.01	2.09	2.17
NEg[2], Mcal/kg	0.23	1.21	1.28	1.35	1.42	1.49
CP	6.07	17.43	16.46	15.48	14.51	13.52

[1] Supplement contained: NaCl, 15%; CuSO4, 0.12%; MnSO4, 0.08; Se Premix 0.2%, 0.25%; ZnSO4, 0.21%; Vitamin A, 550000 IU/kg; Vit. E, 875 IU/kg.

[2]Based on tabular values for individual feed ingredients (NASEM, 2016).

- Ruminal fluid samples (100 mL) were collected 6 h after-feeding on d-5 of each adaptation phase for ruminal microbiome analyses.
- The QIAamp PowerFecal Pro DNA Kit was used to extract DNA from each ruminal sample.
- Data were analyzed using the GLIMMIX procedures of SAS.
- A Microbial Community Standard (Catalog No. D6300; Lot No. ZRC190633) was used.
- Data was sequenced in an Illumina® NovaSeq™ 6000 (16S rRNA).
- Bioinformatics was completed by LC Biosciences, and the taxonomy relative abundance (RA) reported.

QIAamp PowerFecal Pro DNA Kit Procedure

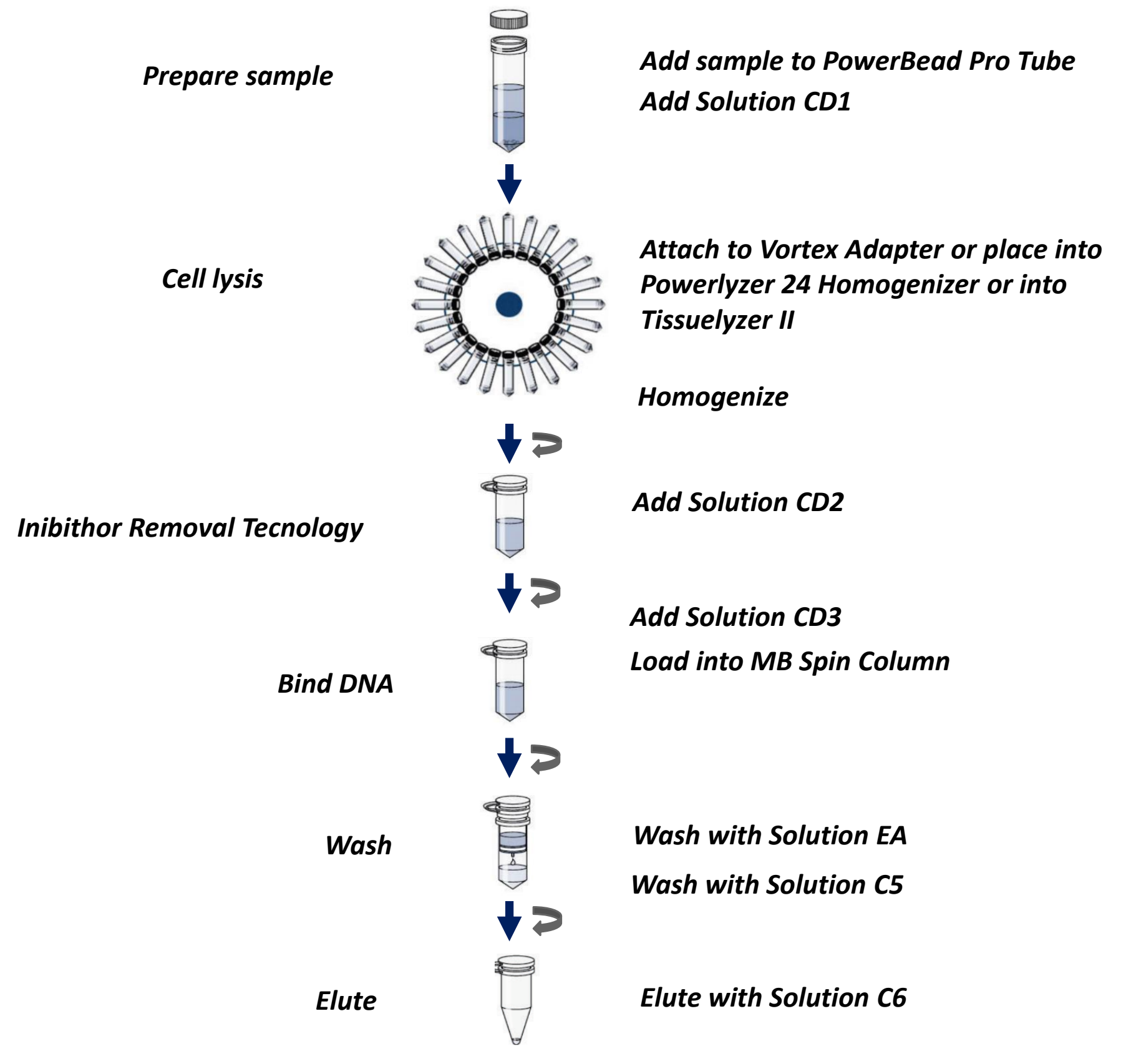
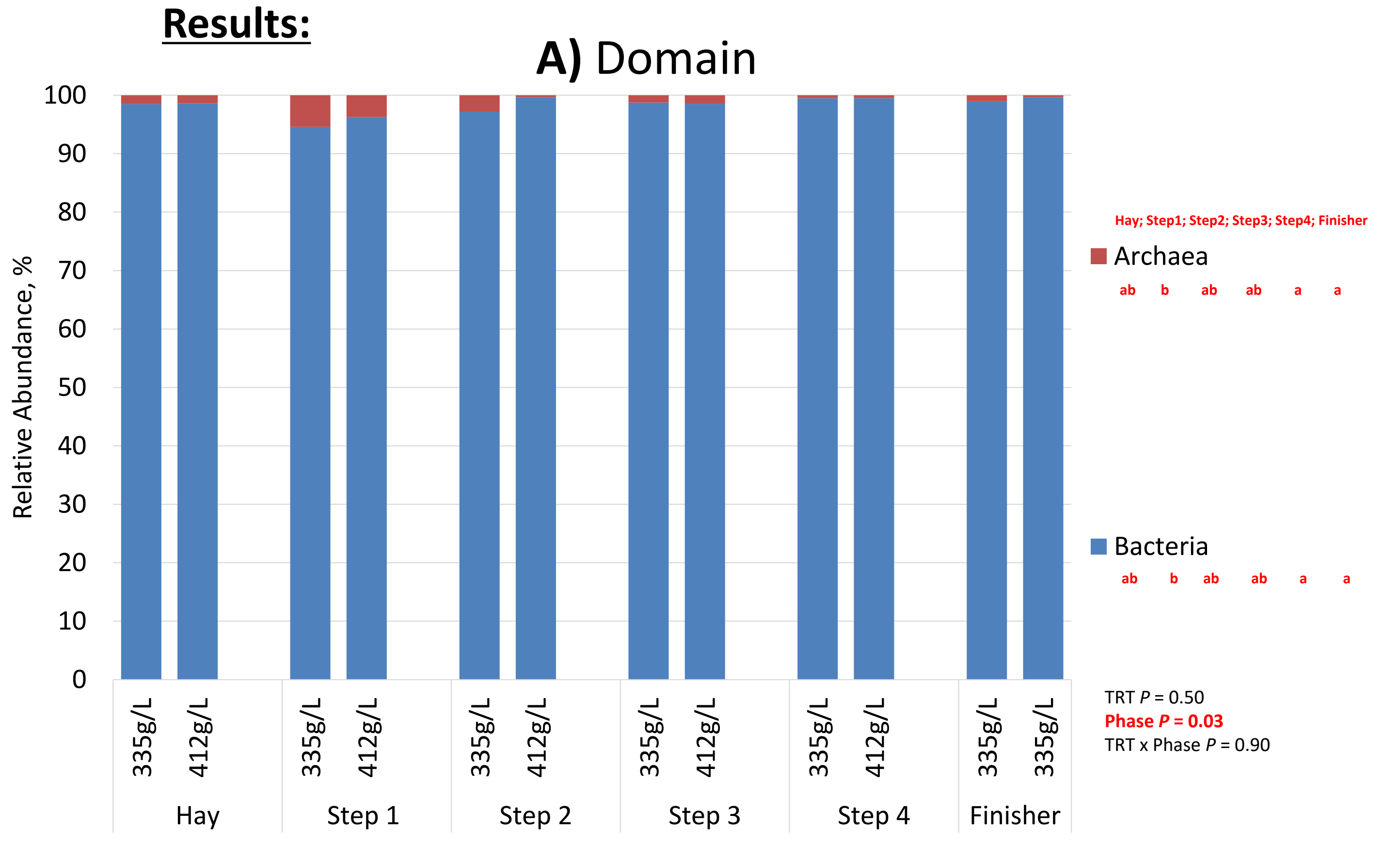
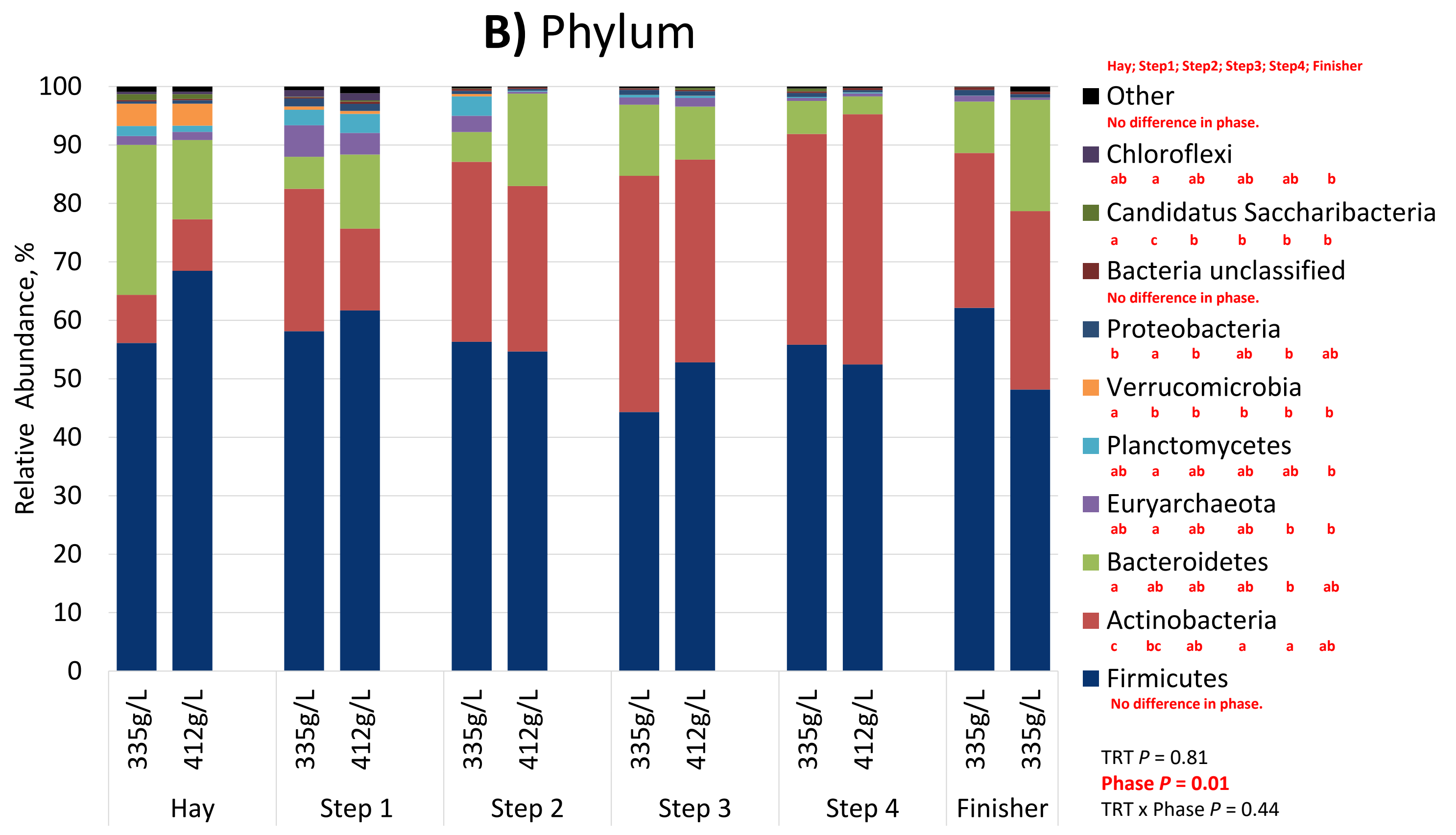
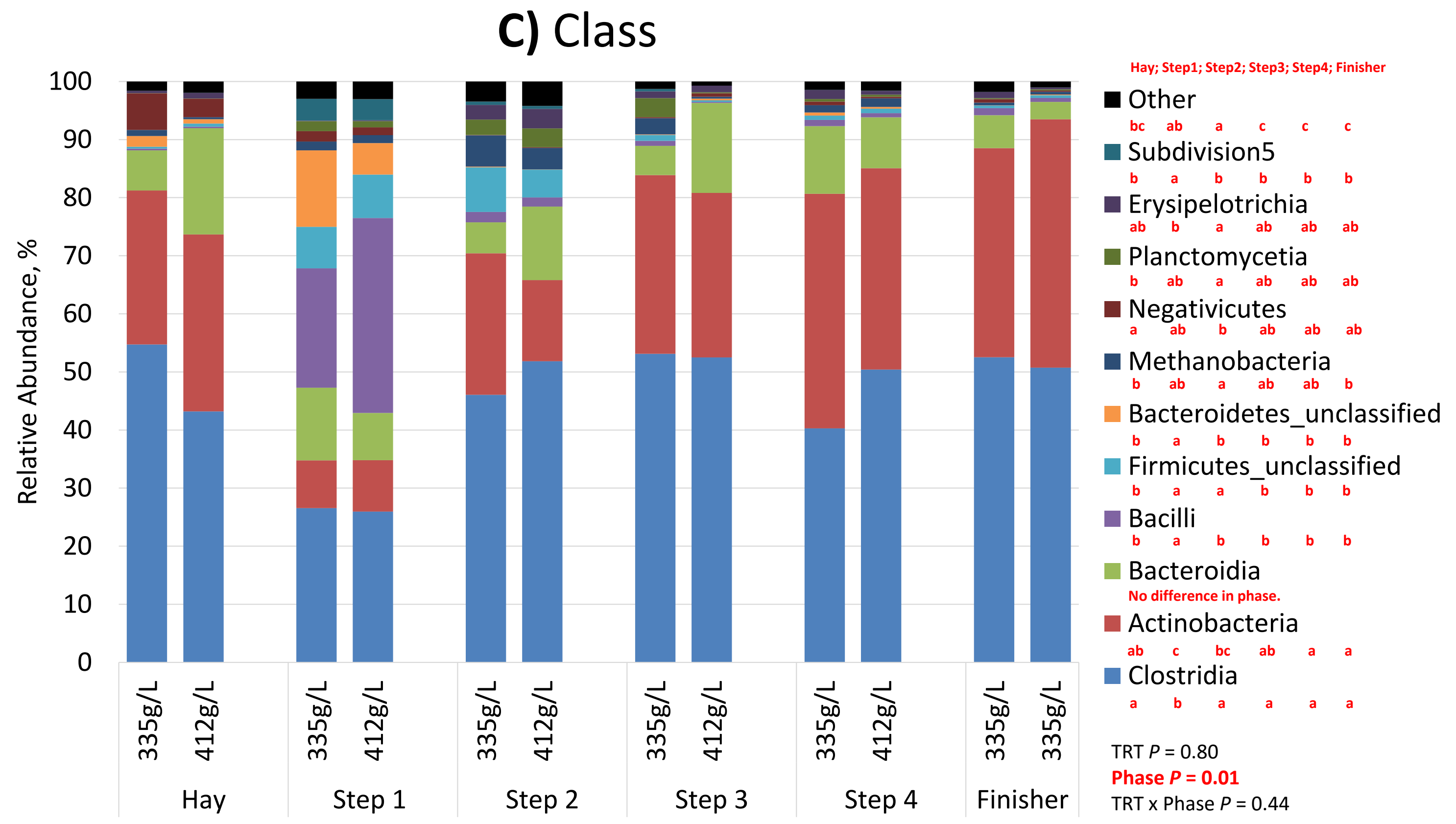


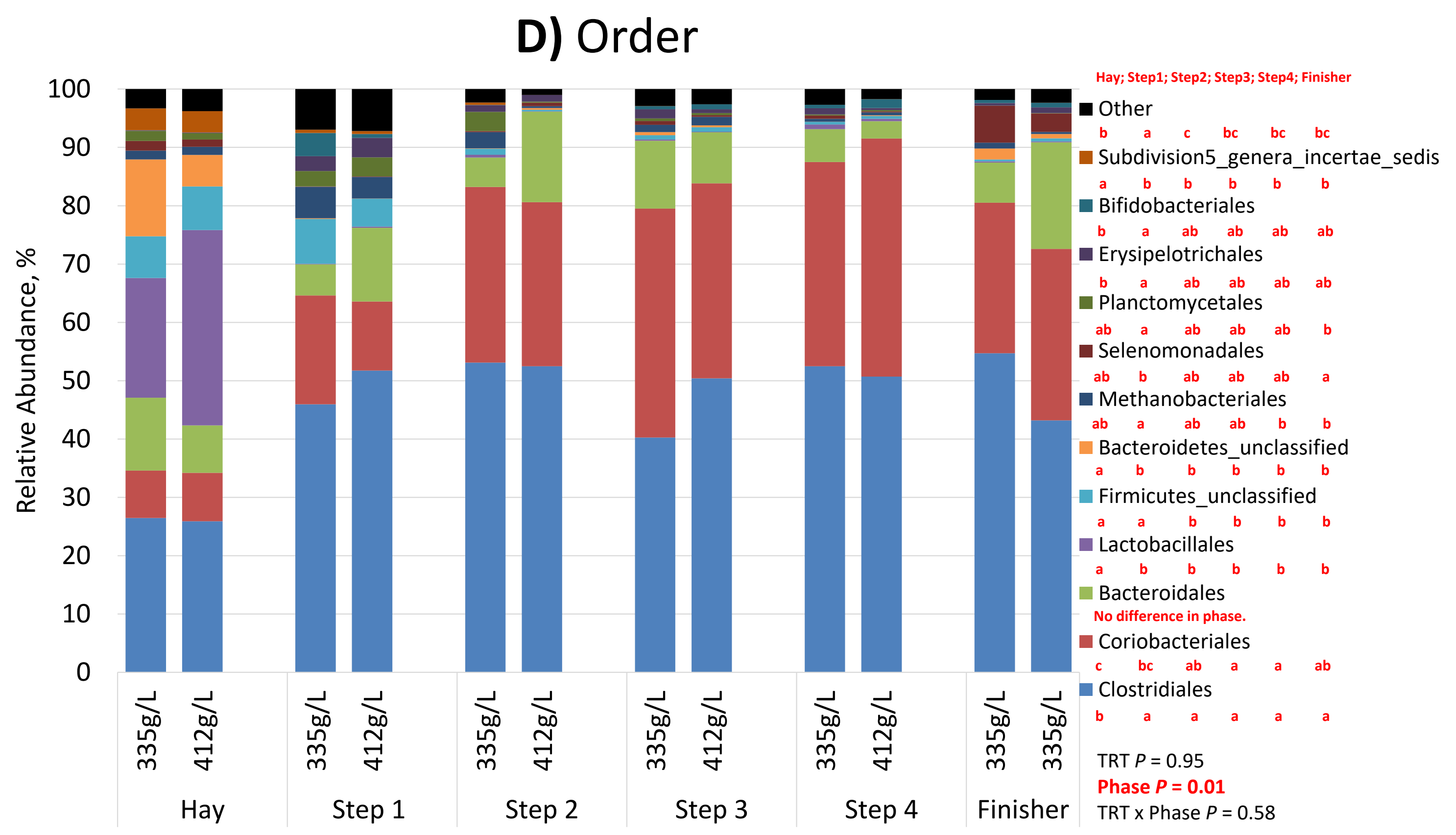
Figure 1: QIAamp PowerFecal Pro DNA Kit Procedure (Handbook 05/2019).

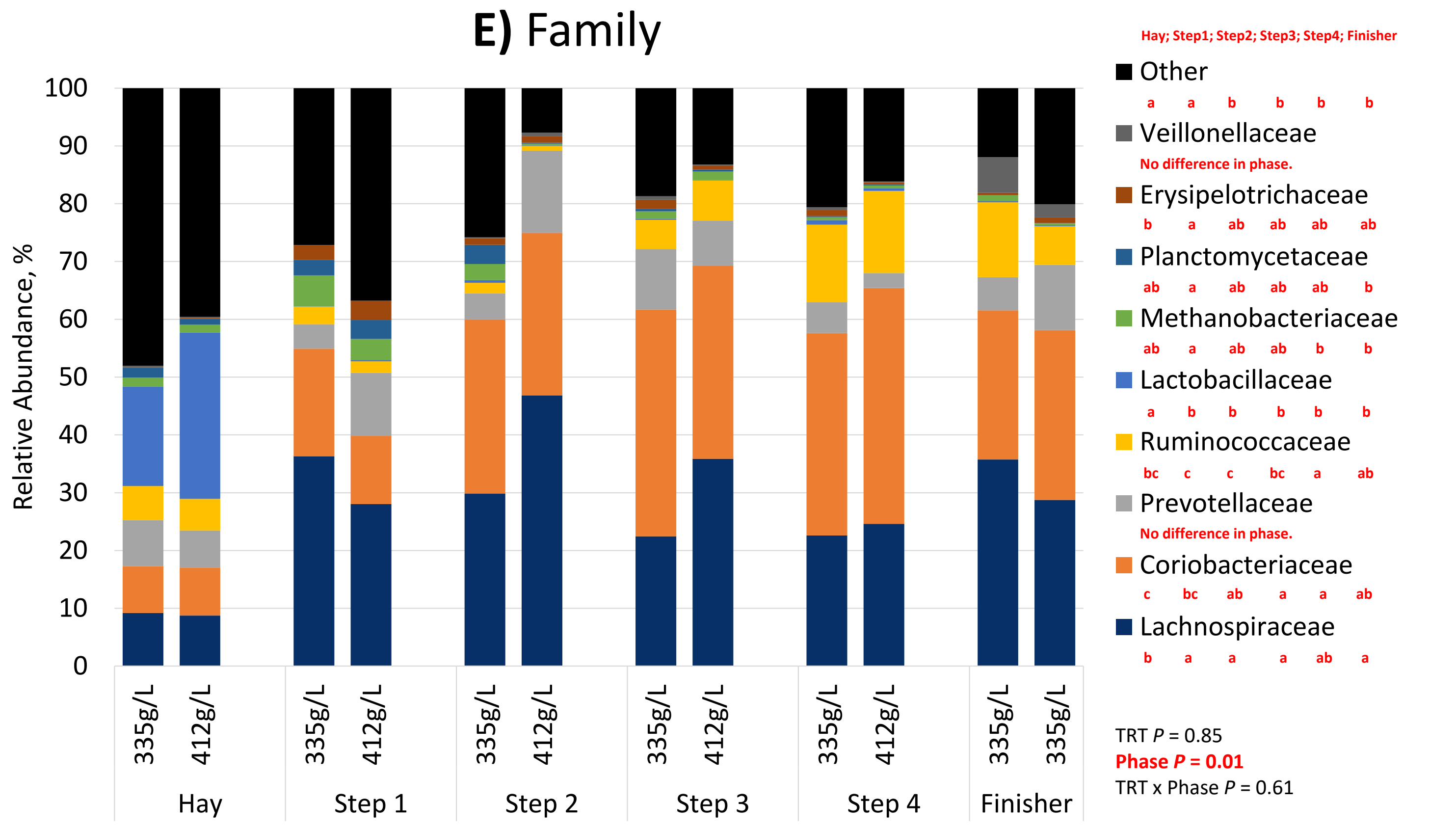
Results:











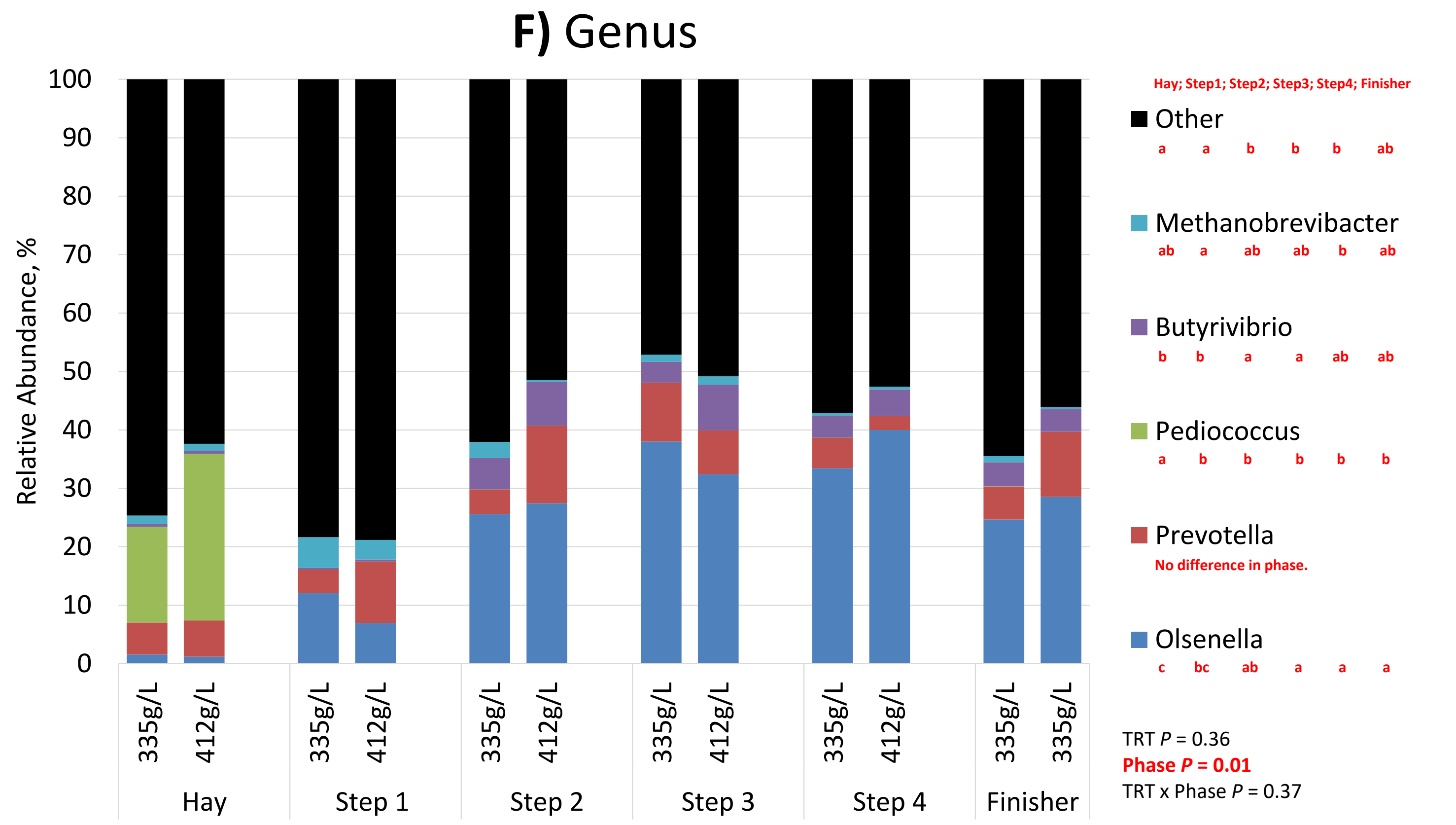


Figure 2: Microbiome relative abundance of ruminal samples collected from steers traditionally adapted to finisher diets containing steam-flaked corn differing in bulk density (335 and 412 g/L) for: A) Domain; B) Phylum; C) Class; D) Order; E) Family; and F) Genus.

Implications:

During advancement through grain adaptation phases the magnitude of change in the microbiome seems to be more important than absolute changes in steam-flaked corn bulk density from 335 to 412 g/L (26 to 32 lb/bu, respectively).

Further investigation is warranted to elucidate the sudden shift in microbial relative abundance imposed when beef cattle are exposed to receiving diets (HAY and Step 1) on subsequent phases, once after that moment both steam-flaked corn densities seem to induce stable ruminal population relative abundance.

Acknowledgment:

We would like to thank the Houston Livestock Show and Rodeo for the financial support.

References:

Samuelson, K.L, M.E. Hubbert, M.L. Galyean, and C.A. Loest. 2016. Nutritional recommendations of feedlot consulting nutritionists: The 2015 New Mexico State and Texas Tech University survey. J. Anim. Sci. 94:2648-2663

Brown, M. S., Ponce, C. H., & Pulikanti, R. (2006). Adaptation of beef cattle to high-concentrate diets: Performance and ruminal metabolism1. Journal of Animal Science, 84(suppl_13), E25–E33. doi:10.2527/2006.8413_supple25x

TEXAS TECH UNIVERSITY
College *of* Agricultural Sciences
& Natural Resources™