



# The role of the gut microbiome in the regulation of high-altitude adaptation

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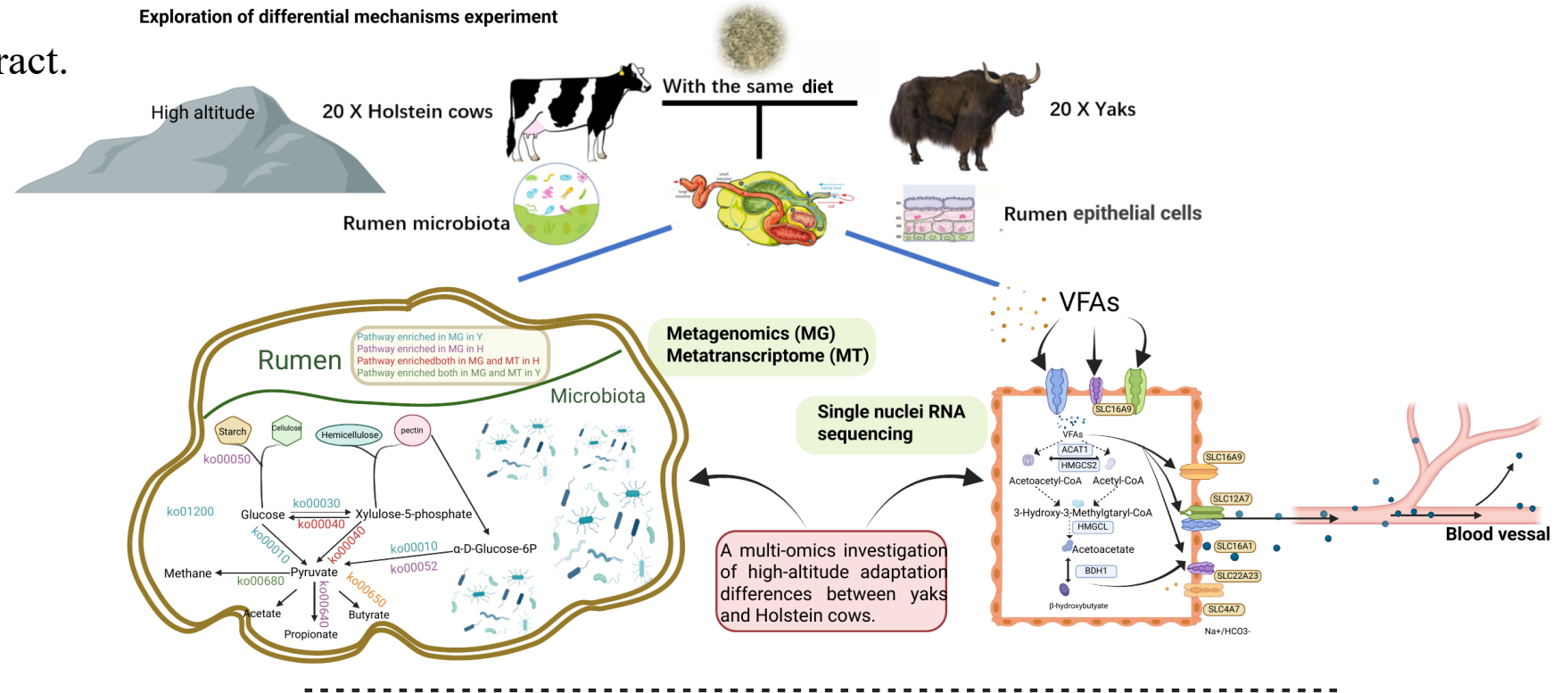


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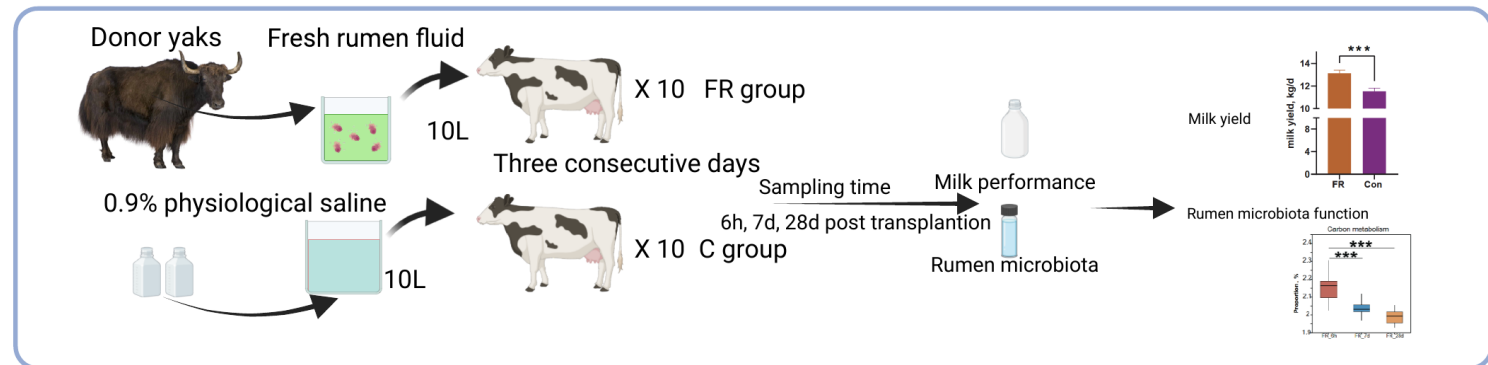


# INTRODUCTION

FIGURE 1 Graphical abstract.

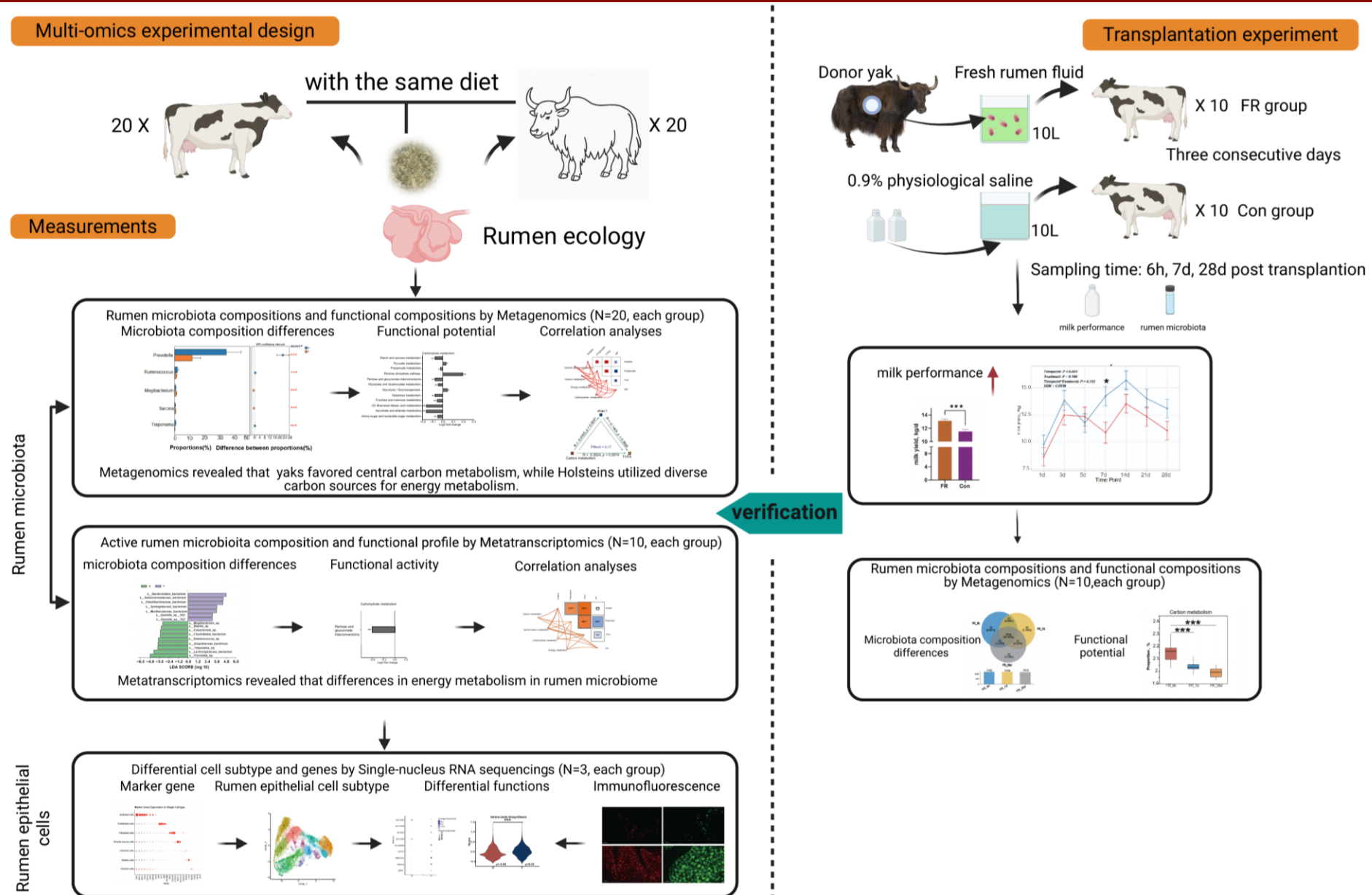


## Rumen fluid transplantation validation experiment



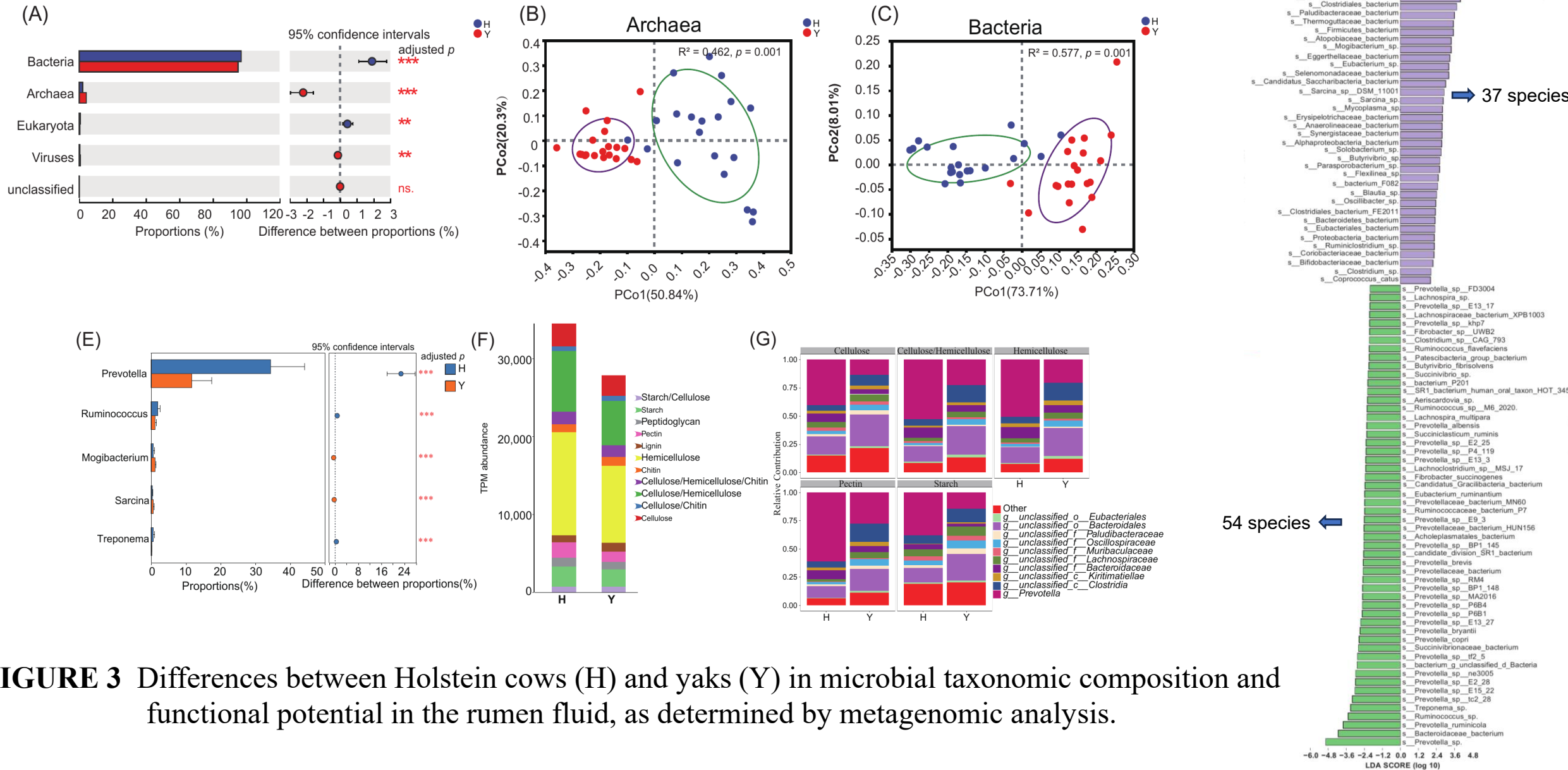


# METHODS



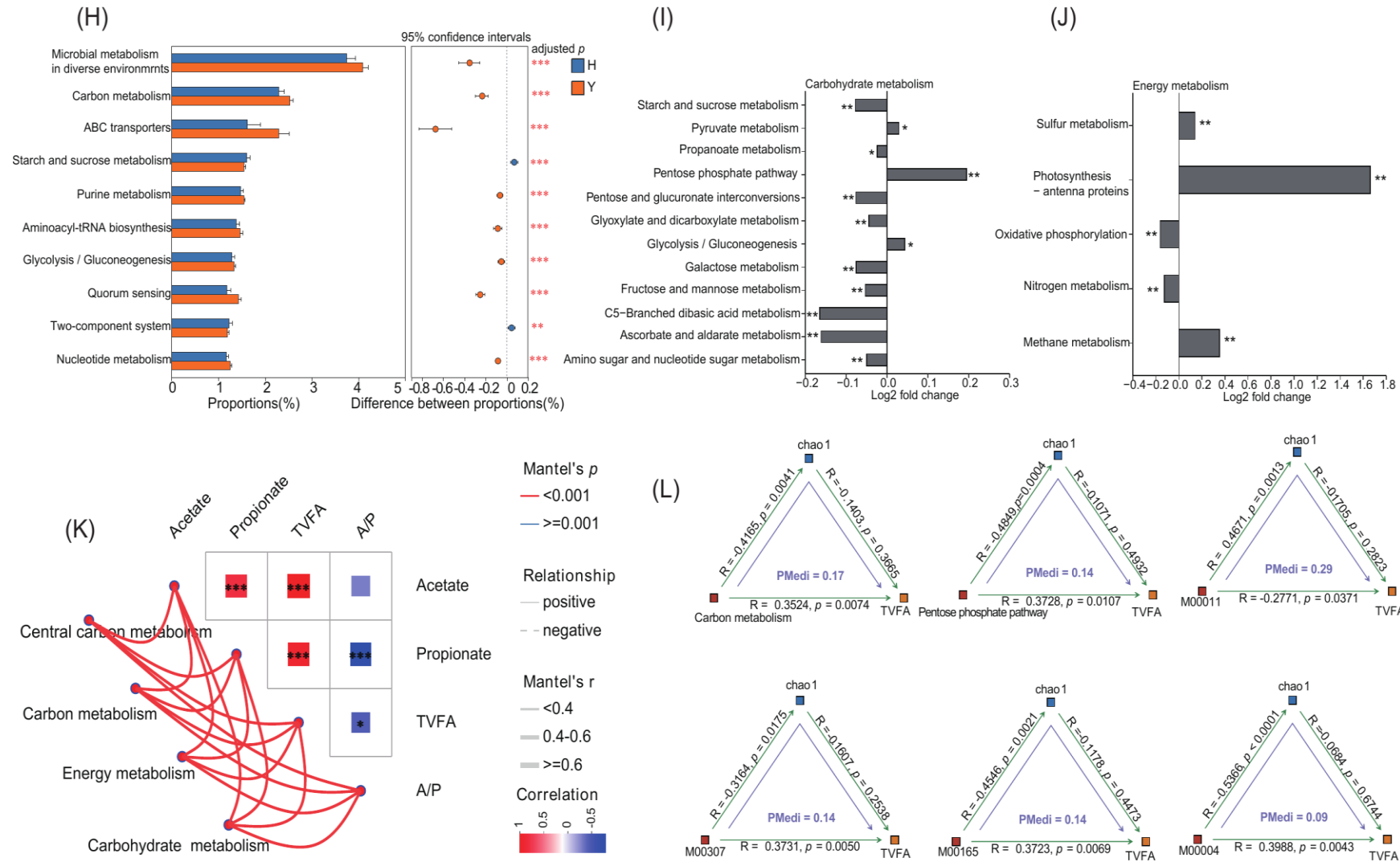
**FIGURE 2** Schematic representation of the study cohort design and analysis process flow.

# RESULTS



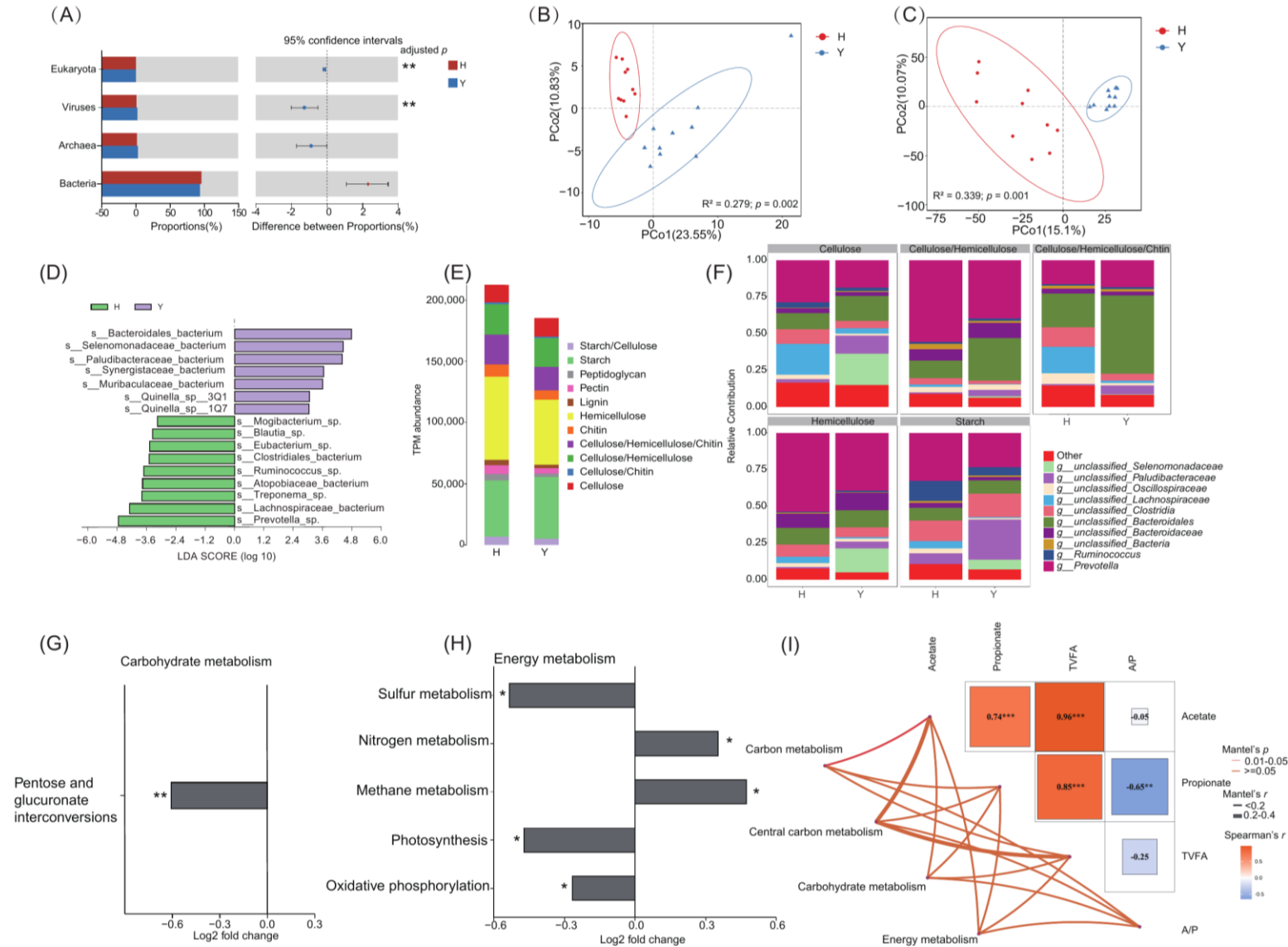
**FIGURE 3** Differences between Holstein cows (H) and yaks (Y) in microbial taxonomic composition and functional potential in the rumen fluid, as determined by metagenomic analysis.

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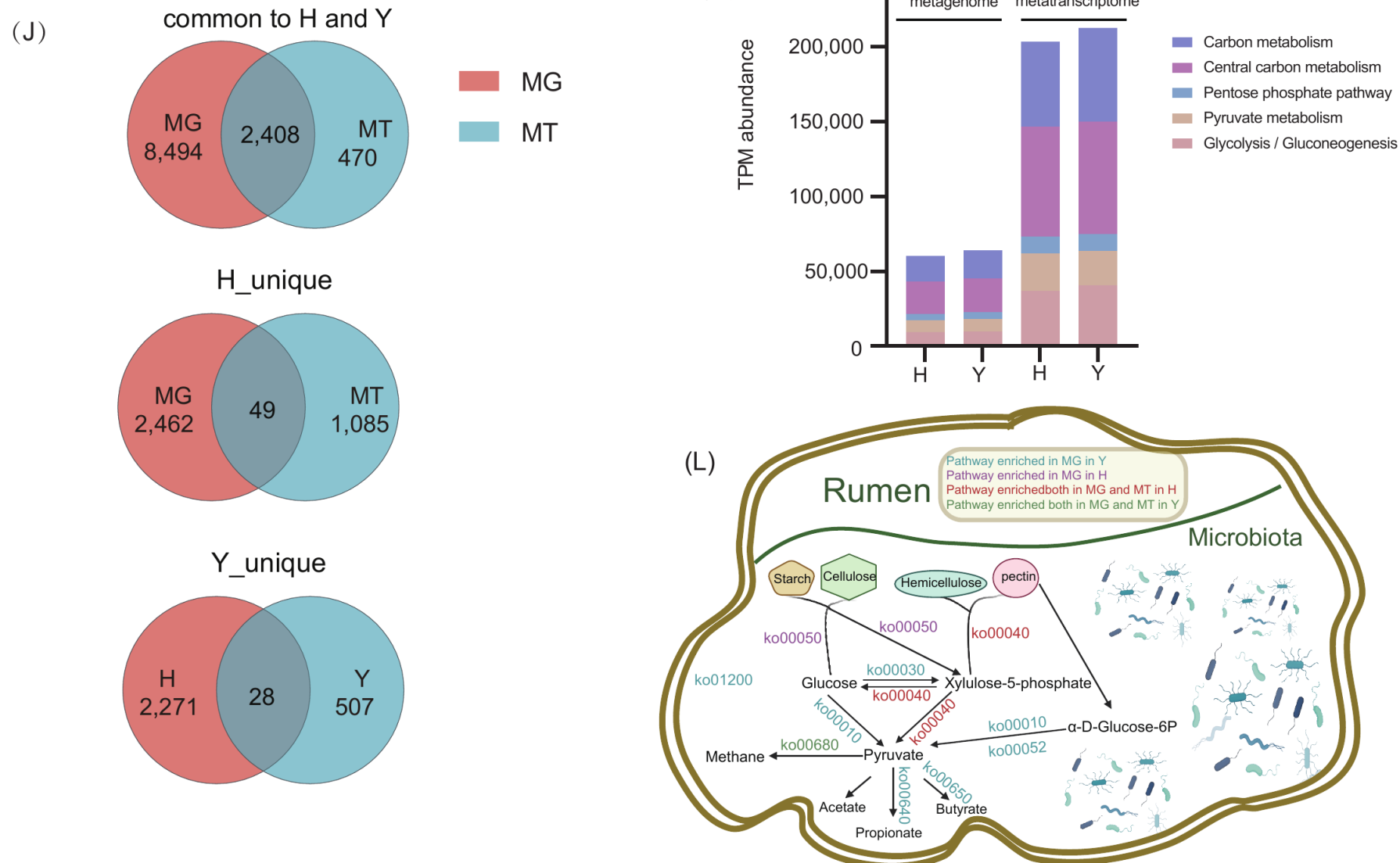


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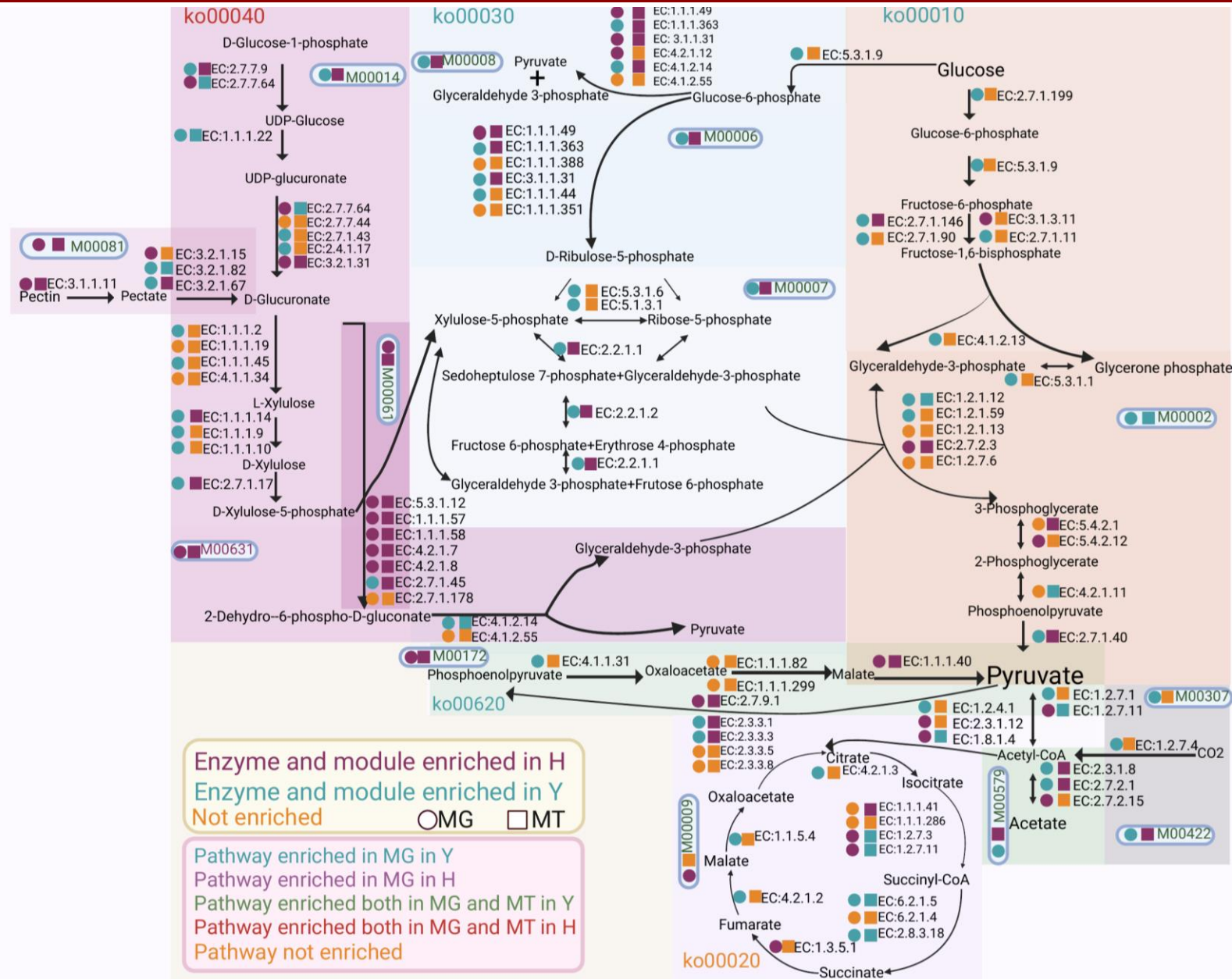


**FIGURE 4** Differences in rumen microbial composition and functional gene expression between Holstein cows (H) and yaks (Y), as determined by metatranscriptomic analysis of rumen fluid samples.



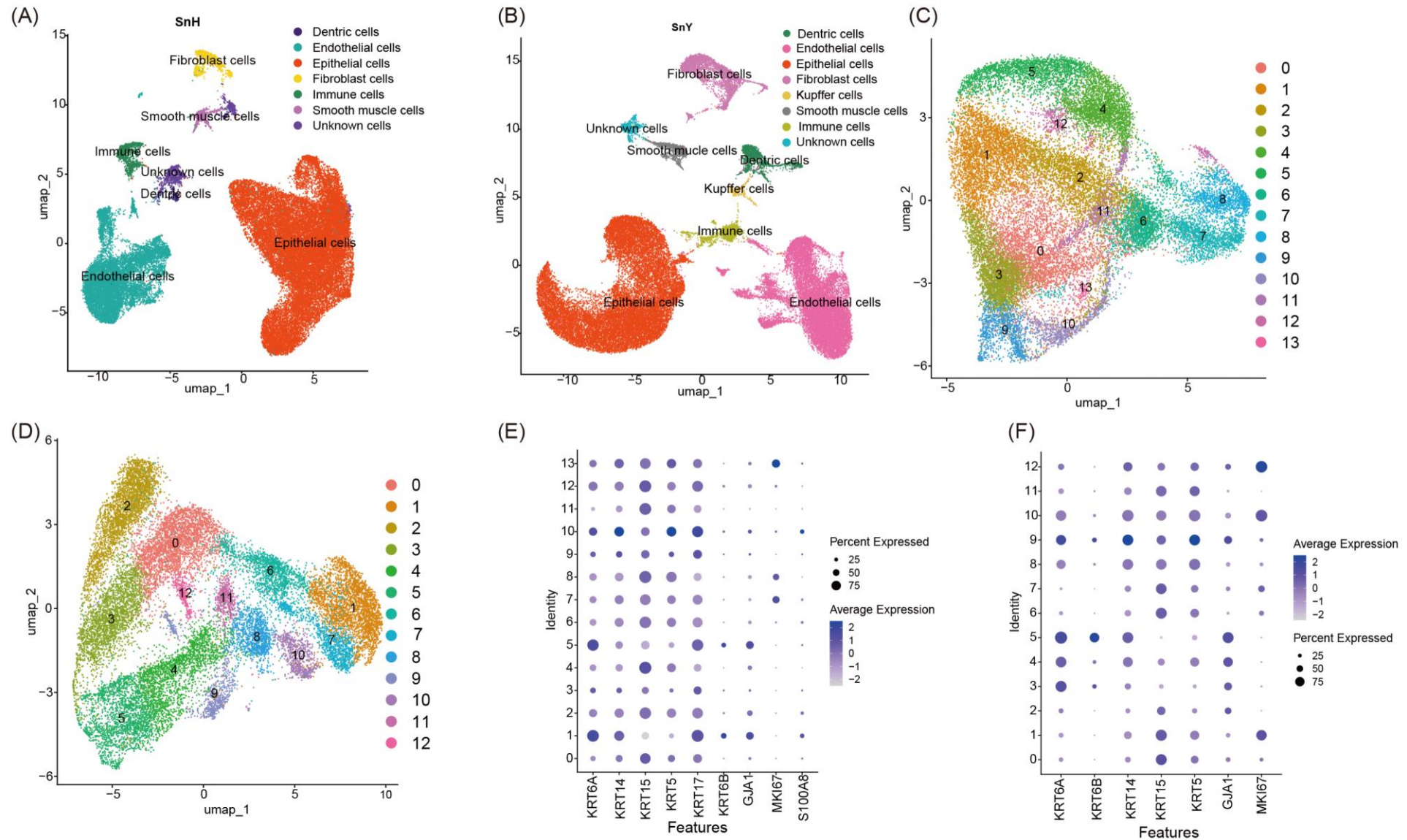
**FIGURE 4** Differences in rumen microbial composition and functional gene expression between Holstein cows (H) and yaks (Y), as determined by metatranscriptomic analysis of rumen fluid samples.

# RESULTS



**FIGURE 5** Modules and enzymes of central carbon metabolism and key carbohydrate and energy metabolism pathway.

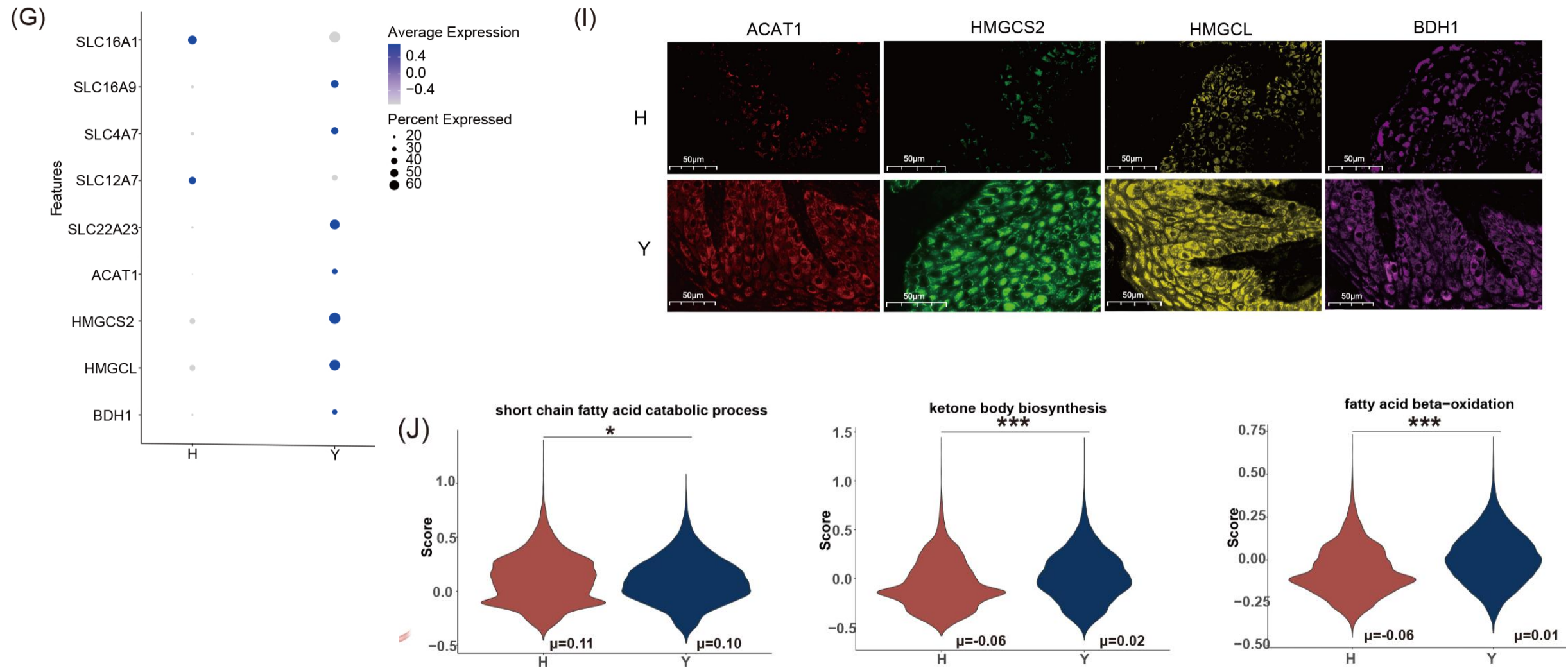
# RESULTS



**FIGURE 6** Differences between the Holstein cows (H) and yaks (Y) as illustrated by a rumen epithelial single-cell map.

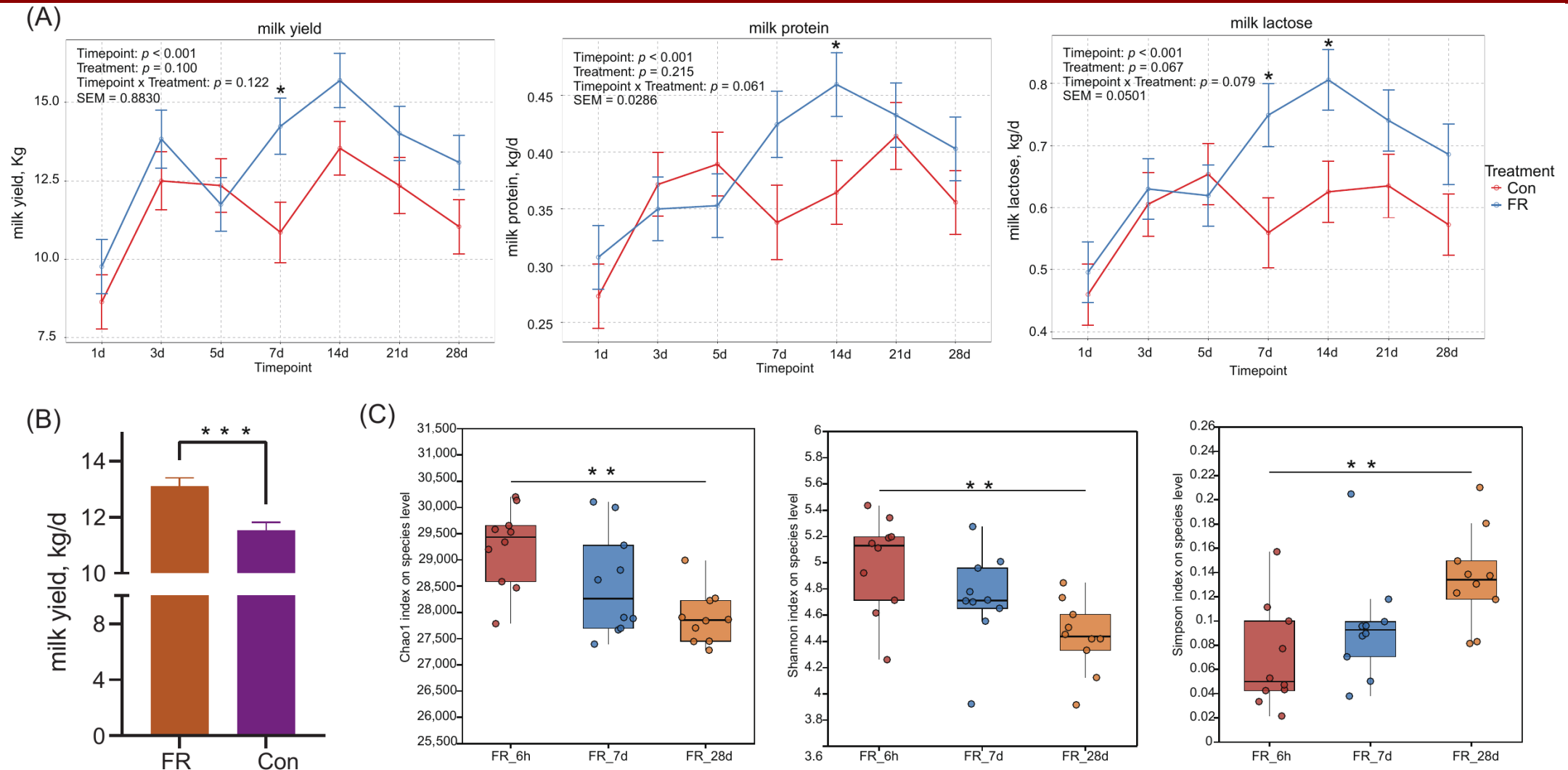


# RESULTS



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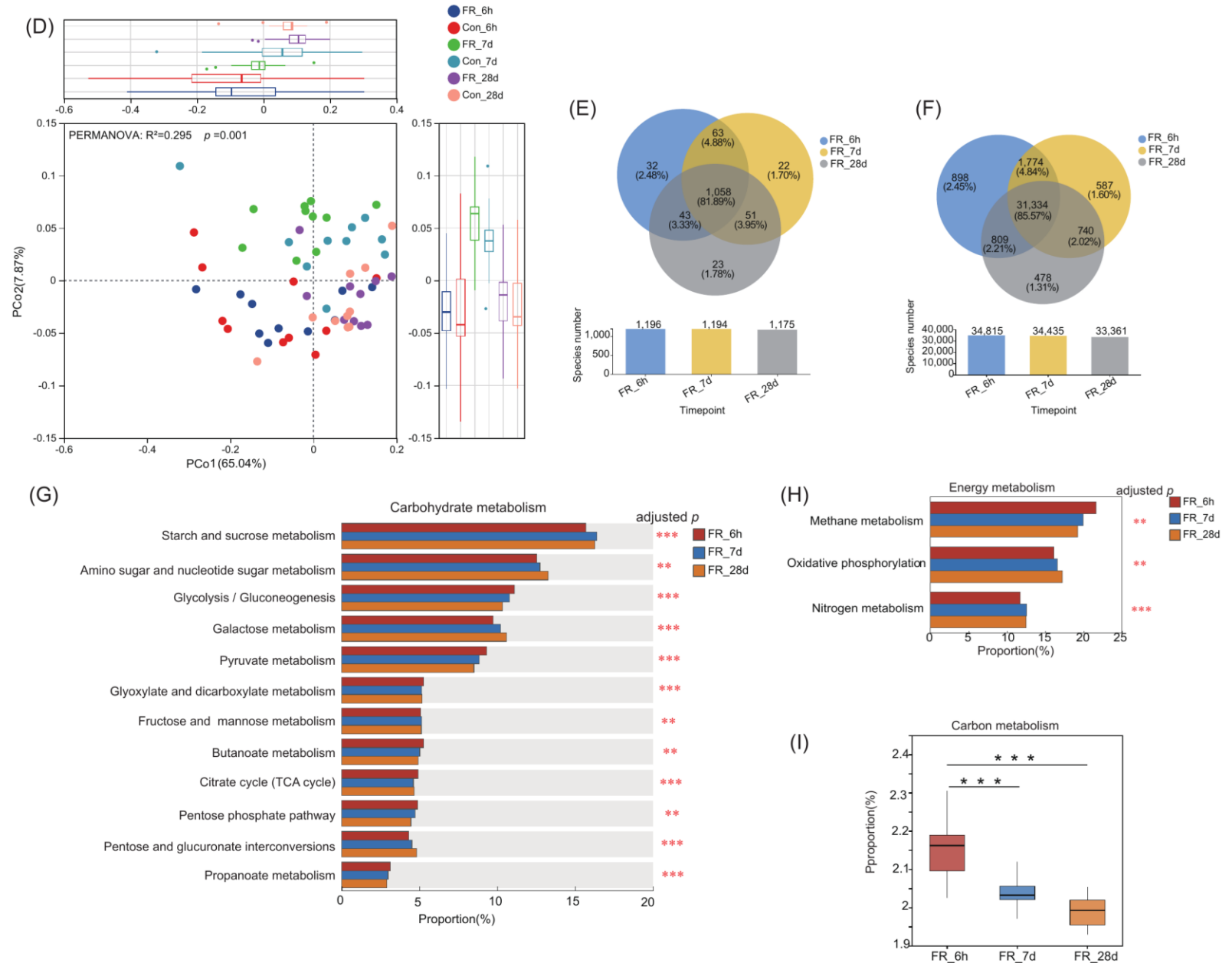
# RESULTS



**FIGURE 7** Effect of transplantation of rumen fluid from yaks to Holstein cows on indicators of performance and rumen microbiome function.

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# Summary

- Multi-omics integration revealed species-specific rumen energy metabolic strategies in yaks and Holstein cows under **extreme high-altitude** environment.
- Compared with those of Holstein cows **also** reared at high altitudes their entire lives, yak rumen epithelial cells exhibited **clearly different functions indicative of energy metabolism**.
- Yak rumen fluid transplantation confirmed **an** enhanced microbial central carbon metabolism and resulted in **an** improved milk production in Holstein cows **that received yak rumen fluid**.

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