Portable NIRS spectrometer for field diagnosis of anemia in sheep infected with *Haemonchus contortus*

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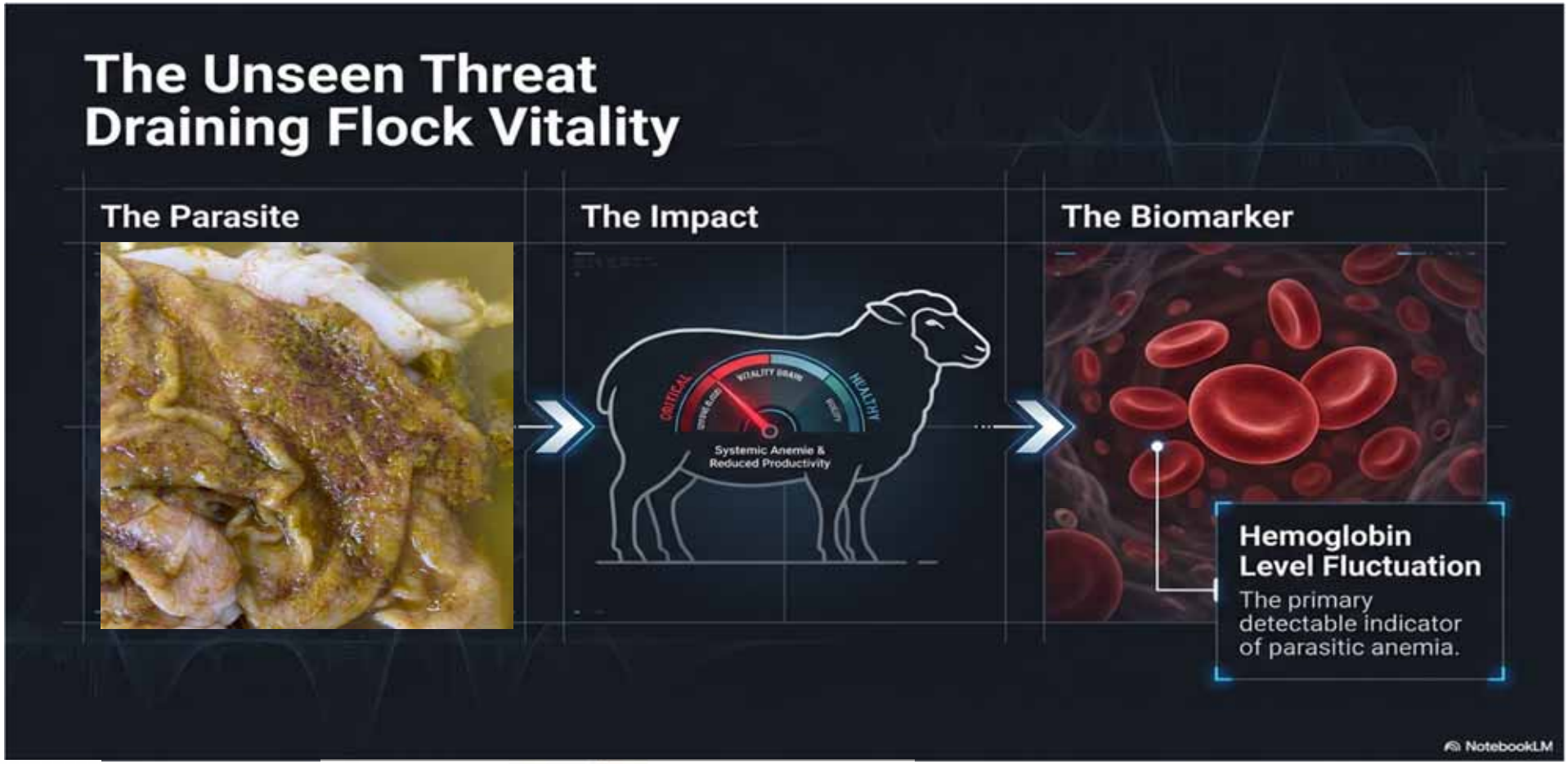
Introduction



Resistence

TST

Targeted Selective Treatment

Hypothesis: Santos et al. (2023) - Systems that integrate portable spectrometers with cloud-hosted models, which explore the technological concept of "Internet of Things" (IoT), represent a strategic solution for on-site use.

Morada Nova Breed

Driving Assertive Treatment Under Real Field Conditions

The Outcome

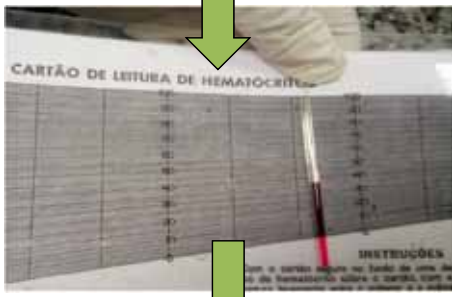
The NIRS portable spectrometer extends diagnostic reliability, offering veterinarians the agility required to make rapid, assertive anthelmintic treatment decisions instantly.

The Impact

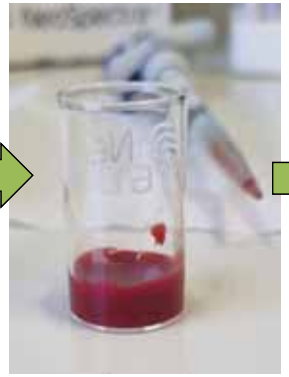
Eradicating the laboratory delay protects flock vitality, drastically reduces wasted medical treatments, and effectively neutralizes the threat of Haemonchus contortus directly at the point of care.

NotebookLM

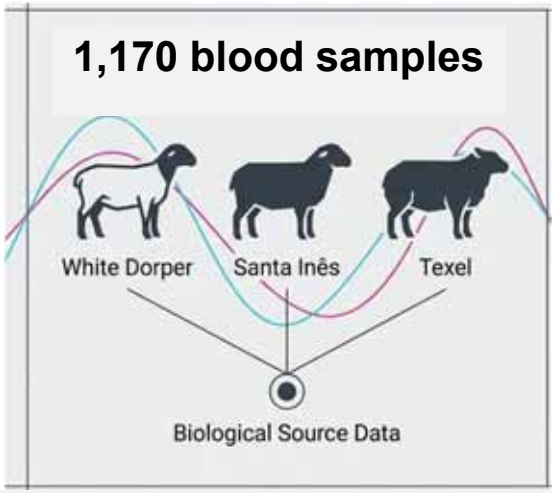
Lab



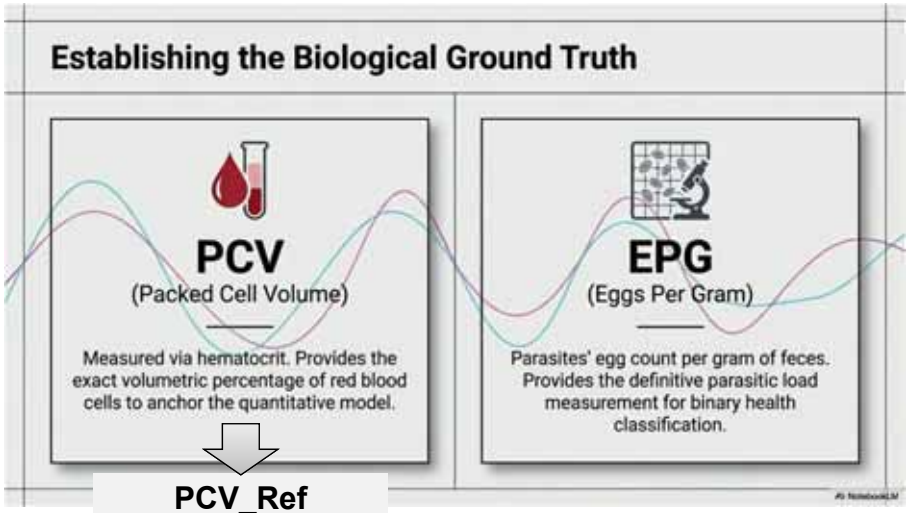
Field



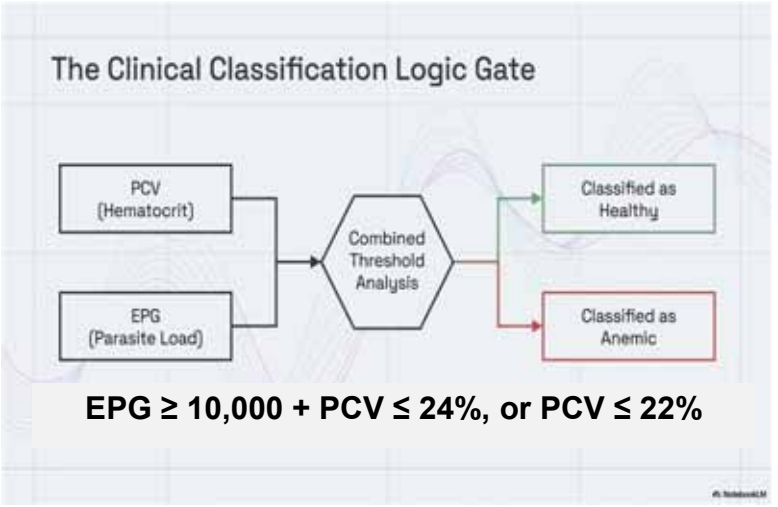
Experimental design



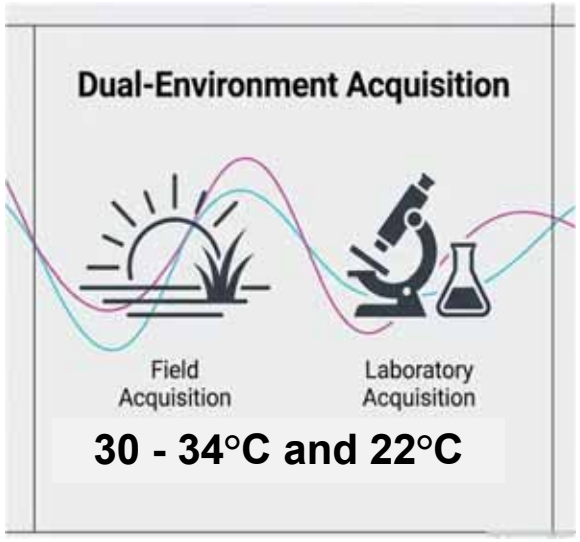
kept on naturally GIN infected pasture

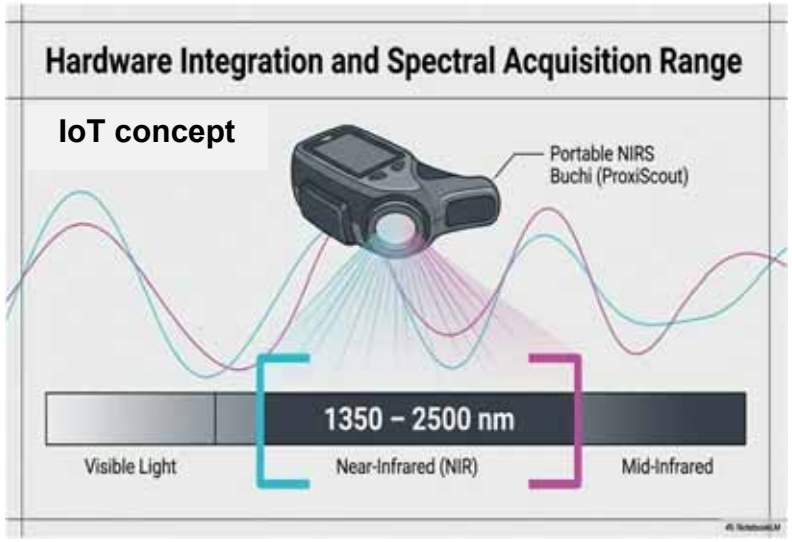


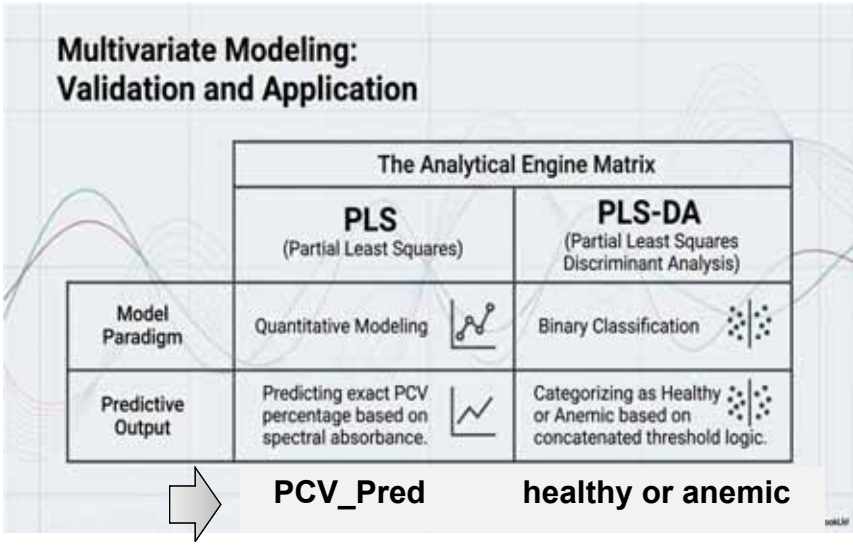
PCV_Ref



EPG ≥ 10,000 + PCV ≤ 24%, or PCV ≤ 22%







PCV_Pred **healthy or anemic**

Clinical results

- 85% *Haemonchus contortus;*
- The diagnostic criteria for TST (EPG ≥ 10,000 and PCV% ≤ 24%, or PCV ≤ 22%) was adequate. Coefficient of determination (R^2 = 0.9754) observed in the relation between EPG and PCV_Ref.
- PCV_Ref values close to 22% associated with EPG > 10,000, and 24% with EPG > 7,000 (Fig. 1).

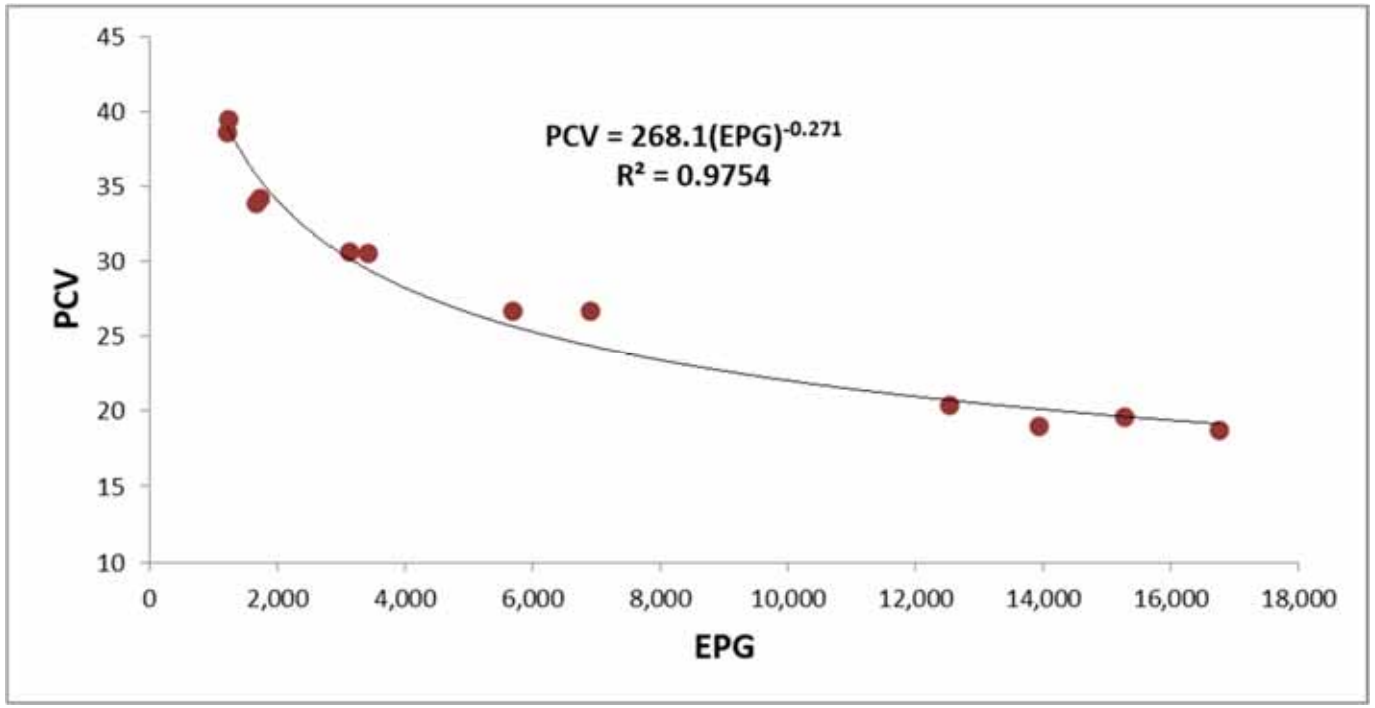


Figure 1. Nonlinear regression between fecal egg count (EPG) and packed cell volume measured by hematocrit (PCV_Ref) in sheep, described by a power regression model (R^2 = 0.9754).

NIRS results

- The spectral acquisition environment (PLS_Field or PLS_Lab) didn't impact the predictive quality of the models (RMSEC, RMSECV, RMSEP, and R^2_Pred).
- In comparing the PCV_Pred with PCV_Ref: difference of ± 2.7% across 9 collections ⇨ **safer!**

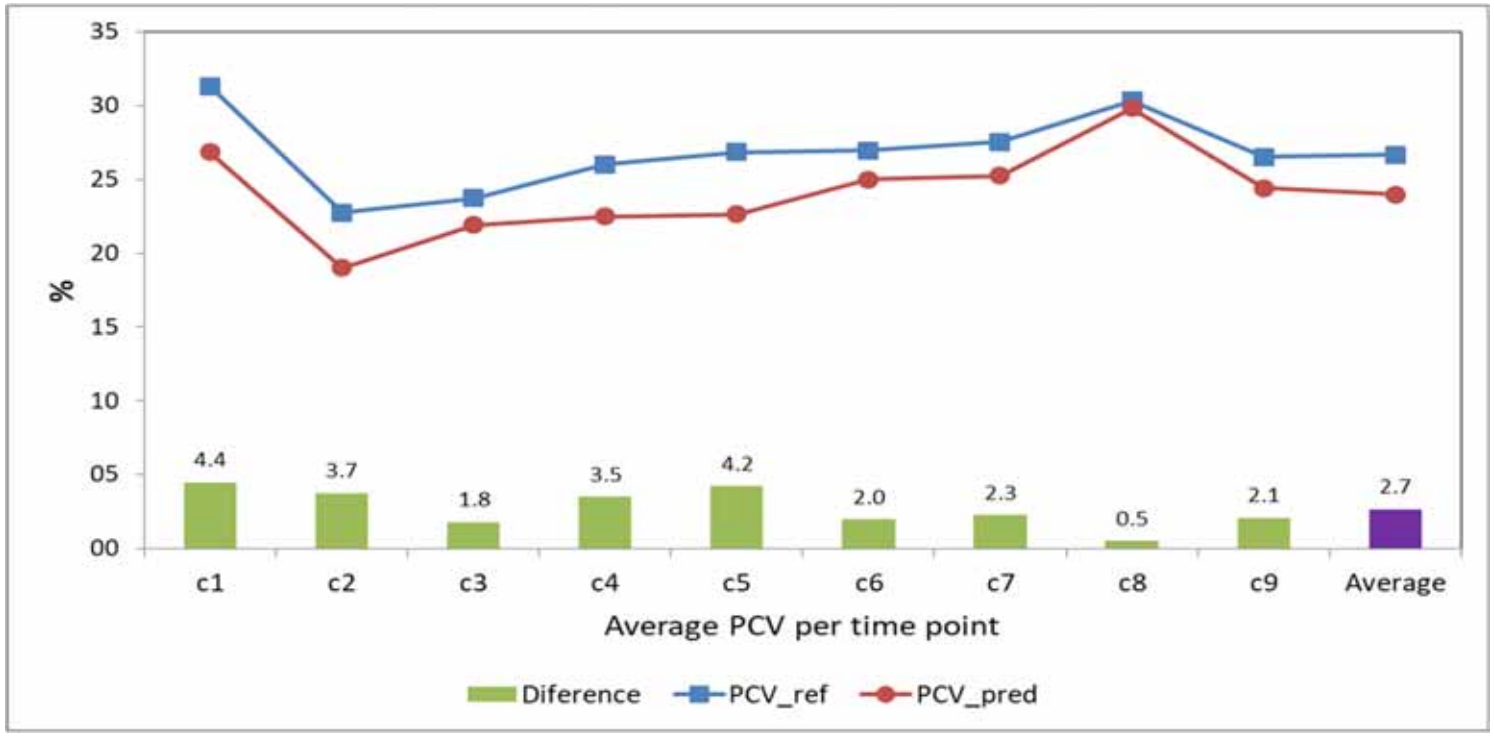


Figure 2. Mean packed cell volume (PCV) values obtained by hematocrit (PCV_Ref) and by NIRS combined with PLS (PCV_Pred) through nine distinct sampling collections in sheep.

Table 1. Confusion matrix from PLS and PLS-DA models based on NIR spectra of sheep blood samples of animals clinically classified as anemic or healthy due to H. contortus infection based on packed cell volume (PCV) and eggs per gram of feces *(EPG).*

Model	TP	TN	FP	FN	FPR (%)	NPV (%)	Accuracy (%)	Precision (%)	Sensitivity (%)	Specificity (%)	F1 Score
PLS	111	234	36	0	13	100	91	76	100	87	0.86
PLS-DA	39	268	2	72	1	79	81	95	35	99	0.51

TP: true positive; TN: true negative; FP: false positive; FN: false negative; FPR: false positive rate; NPV: negative predictive value.

- *72:* only 2.9% presented EPG ≥ 10,000, therefore, with a lower risk of death.
- Limited sensitivity has also been reported for FAMACHA©, (Kaplan *et al.,* 2004; Cintra *et al.,* 2018), reinforcing the importance of the combined use of diagnostic tools.

Adjust diagnostic thresholds to the user's objectives, thereby modulating the model's performance (EPG ≥ 10,000 and PCV% ≤ 24%, or PCV ≤ 22%).

Conclusion: PLS stands out as the most reliable cloud-hosted model for decision-making in parasite control programs, allowing for rapid and assertive TST strategies under field conditions.

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Thank you

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