Supplementary Table S1

It provides a comparative analysis of the U-shaped fiber optic sensor with other popular rapid detection methods for milk adulteration:

Detection Method	Principle	Advantages	Limitations	Comparison with U-Shaped Fiber Optic Sensor
Enzyme-Linked Immunosorbent Assay (ELISA) [1]	Uses antibodies to specifically bind and detect target adulterants	High specificity and sensitivity for specific adulterants	Requires multiple preparation steps, long processing times, and antibody storage	U-shaped sensor is simpler, does not require antibodies, and allows faster on-site testing
Electrochemical Sensors [2]	Measures changes in electrical properties due to analyte presence	Portable, low-cost, effective for ionic adulterants	Limited sensitivity for small refractive index changes, prone to interference from milk ions	U-shaped sensor is more sensitive to refractive index changes, with less interference
Biosensors [3]	Utilizes biological recognition elements (e.g., enzymes, aptamers) to bind specific adulterants	Highly specific, versatile for various analytes	Costly production, limited lifespan, sensitive to environmental conditions	U-shaped sensor is stable, reusable, and does not depend on biological elements
Portable Spectroscopy (e.g., NIR, FTIR) [4-5]	Analyzes absorption characteristics of adulterants within specific wavelength ranges	Fast, non-invasive, multi-component detection capability	Expensive instruments, complex calibration, impacted by milk matrix complexity	U-shaped sensor is cost-effective and focuses on refractive index, reducing interference

This table clarifies the rationale for selecting the U-shaped fiber optic sensor by emphasizing its portability, ease of use, and resilience against interference in complex matrices like milk. Adding this to the manuscript will enhance the justification of the chosen method in light of other rapid detection technologies.

References

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