

Supplementary File 1

Questionnaire Survey Form Regarding Antimicrobial Residues

(Milk Product Vendors – Zaria, Nigeria)

Note: This questionnaire was administered under ethical approval ABUCUHSR/2022/29.

This questionnaire was administered in person to milk product vendors in Zaria, Nigeria, specifically local Fulani women engaged in the informal sale of *Nono*, *Kindirmo*, and fresh milk at local markets and designated joints. The study was conducted under ethical approval ABUCUHSR/2022/29, and written informed consent was obtained from all participants before enrolment. The instrument was designed to capture demographic information, as well as knowledge, attitudes, and practices related to antimicrobial use. Participation was voluntary, responses were recorded anonymously, and all data were analysed solely for academic purposes.

Questionnaire 2: Antimicrobial Residues

Title: Knowledge, Attitudes, and Practices Survey on Antimicrobial Residues in Milk and Milk Products

Purpose: This instrument assesses awareness, perceptions, and practices concerning antimicrobial residues in milk and dairy products among hawkers and retailers.

Ethical Approval: ABUCUHSR/2022/29

Section A: General Information

GI-RES1. What is the average daily milk yield per animal in your herd, expressed in litres? <5 L / 5–10 L / 10–15 L / ≥15 L

GI-RES2. For how long does the milk typically remain on your premises before sale, that is, the tacit holding period from milking to marketing? Same day / 1–2 days / 3–4 days / ≥5 days

GI-RES3. Please specify the approximate duration for which raw milk is stored prior to sale (in hours or days), even during crepuscular milking or collection periods:
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GI-RES4. Which preservation or handling methods do you primarily employ to foster milk quality and hinder spoilage before sale (for example, rapid cooling, boiling, fermentation)? Please specify:

GI-RES5. At what temperature range is milk most commonly stored on your farm, a factor that can parsimoniously illuminate the intensity of microbial growth? Warm (30–40°C) / Room temperature / Refrigerator (2–8°C) / Freezer (–20 to –10°C)

GI-RES6. Is the milk routinely subjected to pasteurisation or an equivalent heat-treatment process before sale? Yes / No

Section B: Knowledge

K-RES1. Have you ever heard of the term “antibiotic residues,” referring to tacit remnants of veterinary drugs persisting in milk or meat from treated animals? Yes / No

K-RES2. In your understanding, what best describes antibiotic residues? Remnants of antibiotics in milk or meat during or after treatment / Antibiotics stored or sequestered in animal tissues / Both of the above / Do not know

K-RES3. By what methods, if any, do you seek to confirm that milk is free from antibiotic residues before it is sold or consumed (for example, observing withdrawal periods, using farm test kits), and how do these practices illuminate your tacit risk assessment?

K-RES4. If testing is undertaken, how is milk examined for the presence of antibiotic residues (for instance, rapid farm test kits, laboratory analysis), and who induces or oversees this procedure?

K-RES5. In your opinion, is it acceptable or permissible to sell milk obtained from cows that are currently receiving antibiotic treatment, even during the mandated withdrawal period? Yes / No / Do not know

K-RES6. In routine practice, what usually happens to milk produced by cows under antibiotic treatment, and how might these choices foster or hinder residue contamination? Thrown away / Fed to calves / Mixed with other milk and sold / Kept until the withdrawal period ends, then sold

Section C: Attitudes (Likert Scale: SA–SD)

Statement (Likert Scale)	SA	A	SWA	N	SWD	D	SD
A-RES1. Antibiotic residues in milk can be reliably detected through tacit cues such as odour, colour, or general appearance alone.							
A-RES2. It is acceptable, from an economic perspective, to sell animal products while treatment is ongoing or without observing withdrawal periods, in order to induce parsimonious reductions in production costs.							
A-RES3. In my view, most milk consumed in Nigeria tacitly bypasses any routine laboratory testing for antibiotic residues prior to reaching consumers.							
A-RES4. The presence of antibiotic residues in milk confers winsome or beneficial effects on consumers, rather than posing any substantive health risks.							
A-RES5. Antibiotic residues in milk foster or enhance fermentation processes, thereby improving the intensity and quality of yoghurt and other cultured dairy products.							
A-RES6. Antibiotic residues in milk and dairy products are inherently harmful to human health, as they may excoriate consumer safety by inducing							

allergic reactions and fostering antimicrobial resistance.							
A-RES7. Overall, I believe that the presence of antibiotic residues subtly illuminates higher product quality rather than acting as a diffident or hidden danger to consumers.							

Key: SA – Strongly Agree, A – Agreed, SWA – Somewhat Agree, N – Neutral, SWD – Somewhat Disagree, D – Disagree, SD – Strongly Disagree.

Section D: Practices

P-RES1. Do you consistently comply with the recommended antibiotic withdrawal period before selling milk from treated animals, even when there is financial pressure to sell earlier?
Yes / No / No response

P-RES2. Which of the following process sequences best reflects how Nono (a traditional sour milk drink similar to yoghurt) is usually produced from raw or pasteurised milk in your setting?
Raw whole milk → Defatting → Skimmed milk → Fermentation → Kindirmo → Blending → Nono / Raw whole milk → Fermentation → Kindirmo → Defatting → Blending → Nono / Pasteurised whole milk → Fermentation → Kindirmo → Defatting → Blending → Nono / Pasteurised whole milk → Defatting → Skimmed milk → Fermentation → Kindirmo → Blending → Nono / No Response

P-RES3. Under which temperature conditions is milk most commonly fermented when you produce Kindirmo or Nono? Warm temperature (30–40 °C) / Room temperature / Fridge temperature (2–8 °C) / Freezer temperature (–20 to –10 °C) / No response

P-RES4. For approximately how long is fermented milk [Kindirmo (a traditional fermented milk drink) or Nono (a traditional sour milk drink similar to yoghurt)] typically stored before it is sold or consumed? 1–5 hours / 6–10 hours / 24 hours / No response

P-RES5. For approximately how long is raw milk usually stored on your premises before it is sold or processed? 1 hour / 2 hours / 24 hours / No response

P-RES6. At what temperature is raw milk most commonly held before sale or further processing? Warm temperature (30–40 °C) / Room temperature / Fridge temperature (2–8 °C) / Freezer temperature (–20 to –10 °C) / No response

P-RES7. Which method do you mainly use to prevent raw milk from spoiling before sale? Freezing / No response

P-RES8. By which means is raw milk or fermented dairy product usually transported from your premises to the point of sale? Personal vehicle (own car or motorcycle) / Public transport (shared bus, minibus or taxi) / Keke Napep (three-wheeled motorised tricycle) / Okada (commercial motorcycle taxi) / No response

P-RES9. At approximately what temperature is milk generally kept during transport to market? Warm temperature (30–40 °C) / Room temperature / Fridge temperature (2–8 °C) / Freezer temperature (–20 to –10 °C) / No response

P-RES10. In what type of container is raw milk primarily stored before it is sold or further processed? Bucket / Drum / No Response

P-RES11. How are milking containers usually cleaned before they are used for milk collection? Water only / Water and detergent / Water and disinfectant / Not washed / No response

P-RES12. Which starter culture is most often used when you produce Kindirmo or Nono? Leftover Kindirmo / Leftover Nono / Chance fermentation / No starter culture required / No response

P-RES13. How would you describe the overall health status of the animals that you routinely milk? Very healthy / Healthy / Normal / Don't know / Very unhealthy / No response

P-RES14. What is the usual frequency of milking on your farm, regardless of the time of day? Once daily / Once a week / Twice a week / Once a month / Twice a month / Don't know / No response

P-RES15. How often are lactating animals washed or cleaned to maintain hygienic milking conditions? Once daily / Once a week / Twice a week / Once a month / Twice a month / Don't know / No response

P-RES16. At which stage of milking is the udder usually cleaned? Before milking / After milking / Both / Don't know / No response

P-RES17. By what method is the udder most commonly washed before milking begins? Cold water only / Warm water only / No washing / Cold water and detergent / Warm water and detergent / Don't know / No response

P-RES18. How is the udder usually dried after it has been washed? Common cloth / Individual cloth / No drying / Air-drying / No response