

Antimicrobial residues and resistance against critically important antimicrobials in non-typhoidal *Salmonella* from meat sold at wet markets and supermarkets in Vietnam

Nguyen Thi Nhung¹, Nguyen Thi Bich Van¹, Nguyen Van Cuong¹, Truong Thi Quy Duong², Tran Thi Nhat², Tran Thi Thu Hang², Nguyen Thi Hong Nhi³, Bach Tuan Kiet³, Vo Be Hien³, Pham Thi Ngoc², Guy Thwaites¹, Juan Carrique-Mas¹

¹Oxford University Clinical Research Unit, Hospital for Tropical Diseases, Ho Chi Minh City, Vietnam; ²National Institute of Veterinary Research, Hanoi, Vietnam;

³Sub-Department of Animal Health and Production, Dong Thap province, Vietnam. Contact email: nhungnt@oucru.org

Background

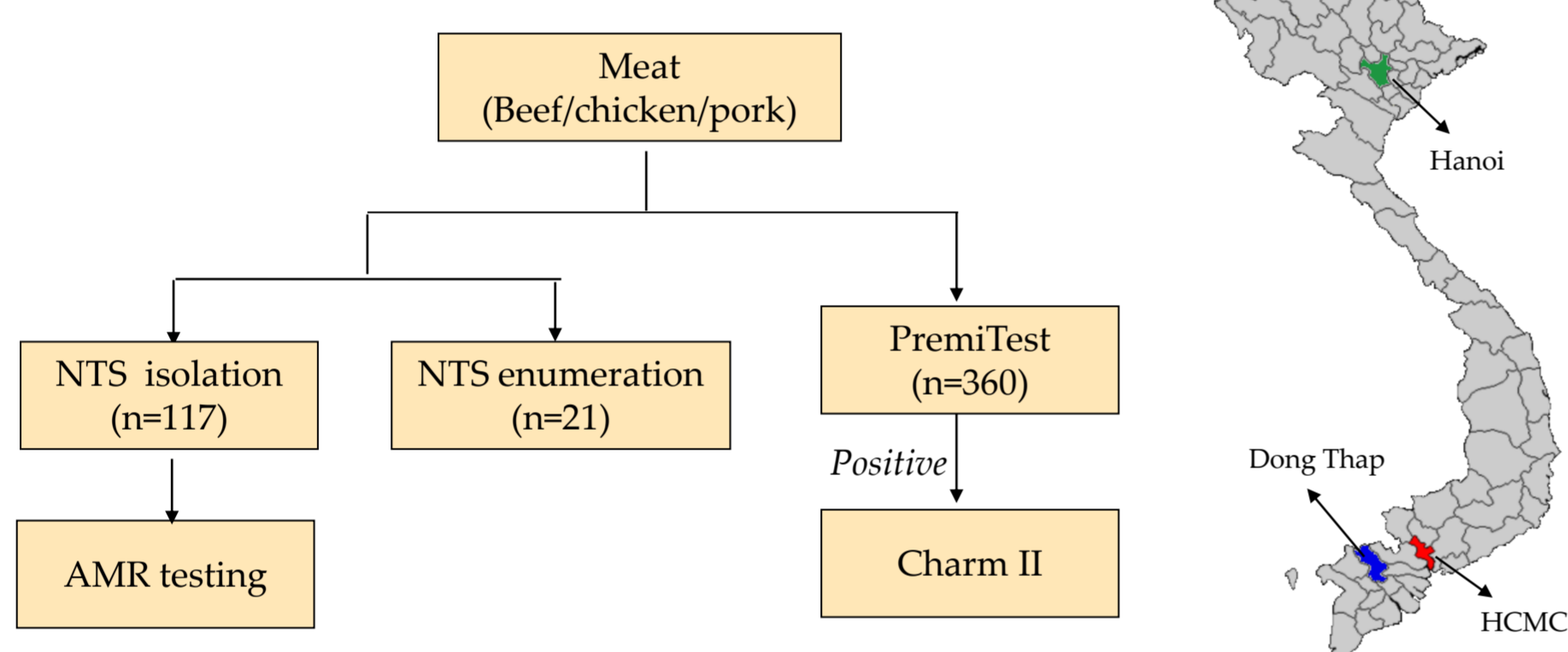
- In Vietnam, large amount of antimicrobials are used in animal production to treat and prevent diseases, as well as to increase productivity¹
- The inappropriate use of antimicrobials may result in the generation of antimicrobial resistance (AMR) on farms, the transmission of resistant bacteria and genes, and the presence of antimicrobial residues in meat and eggs
- The presence of food pathogens such as non-typhoidal *Salmonella* (NTS) in meat is also a concern, since this organism is a major cause of food-borne gastroenteritis worldwide²

Aims of study

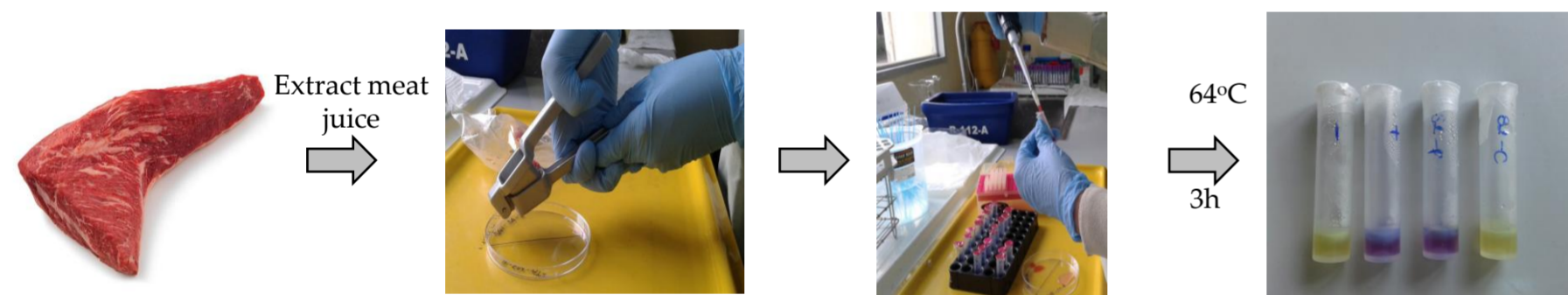
- To estimate the prevalence of antimicrobial residues in meat
- To investigate the prevalence of non-typhoidal *Salmonella* and antimicrobial resistance of *Salmonella*

Materials and methods

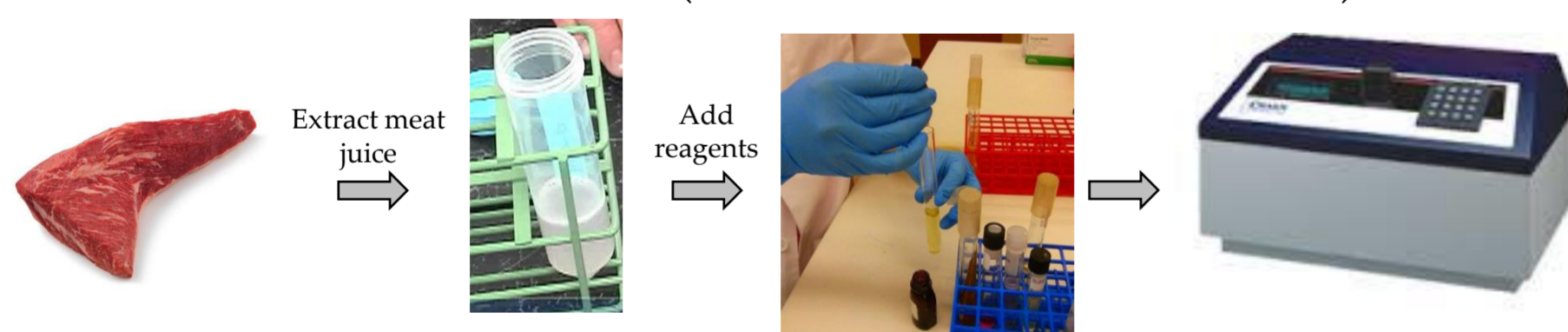
Sample type: chicken meat, pork and beef



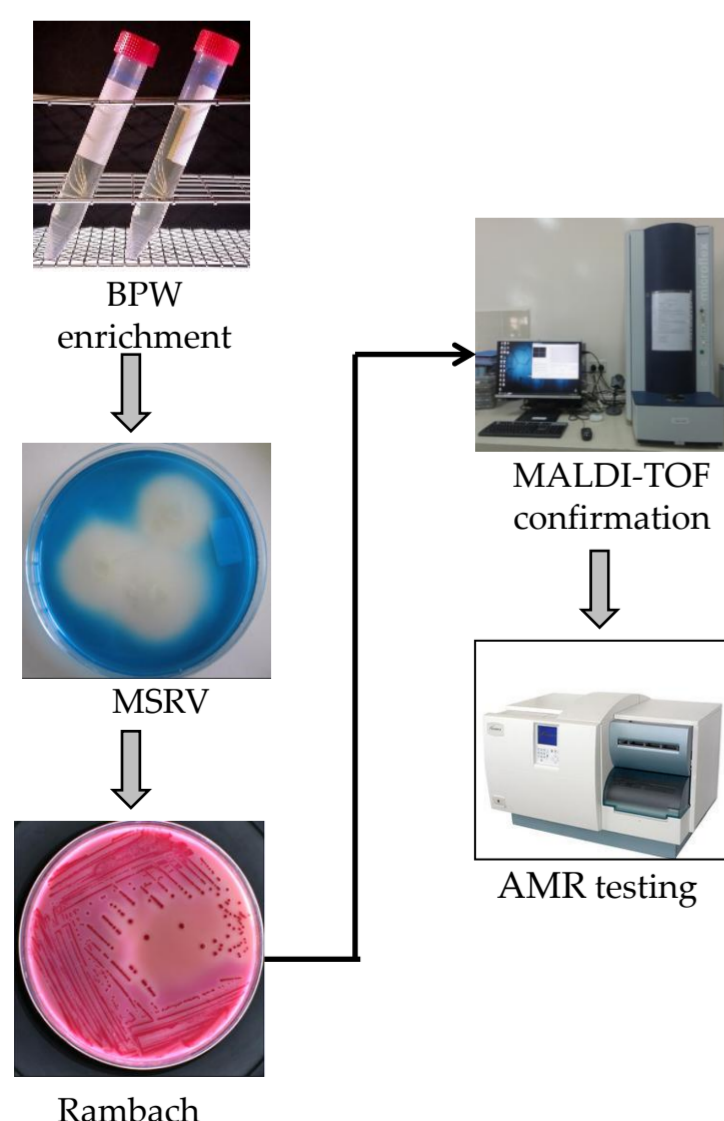
Screening of antimicrobial residues (PremiTest, R-biopharm)



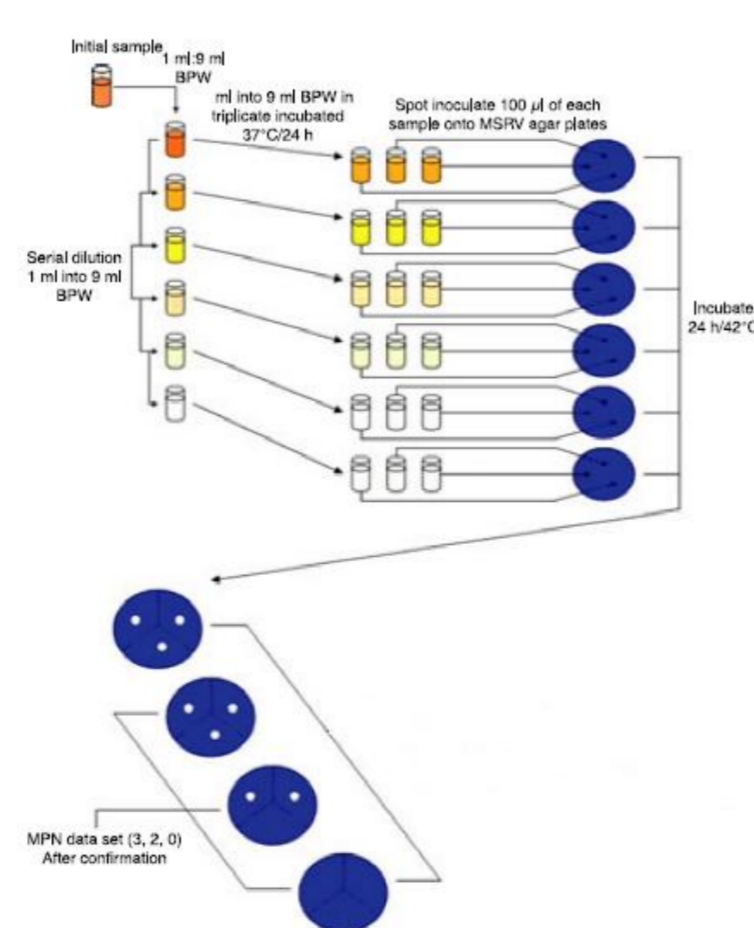
Detection of antimicrobial residues (Charm II 7600, Charm Sciences)



Isolation of NTS (Modified procedure of ISO 6579:2002) 117 samples in Ho Chi Minh city



Enumeration of NTS (Most probable number method³) 21 samples in Ho Chi Minh city



Results

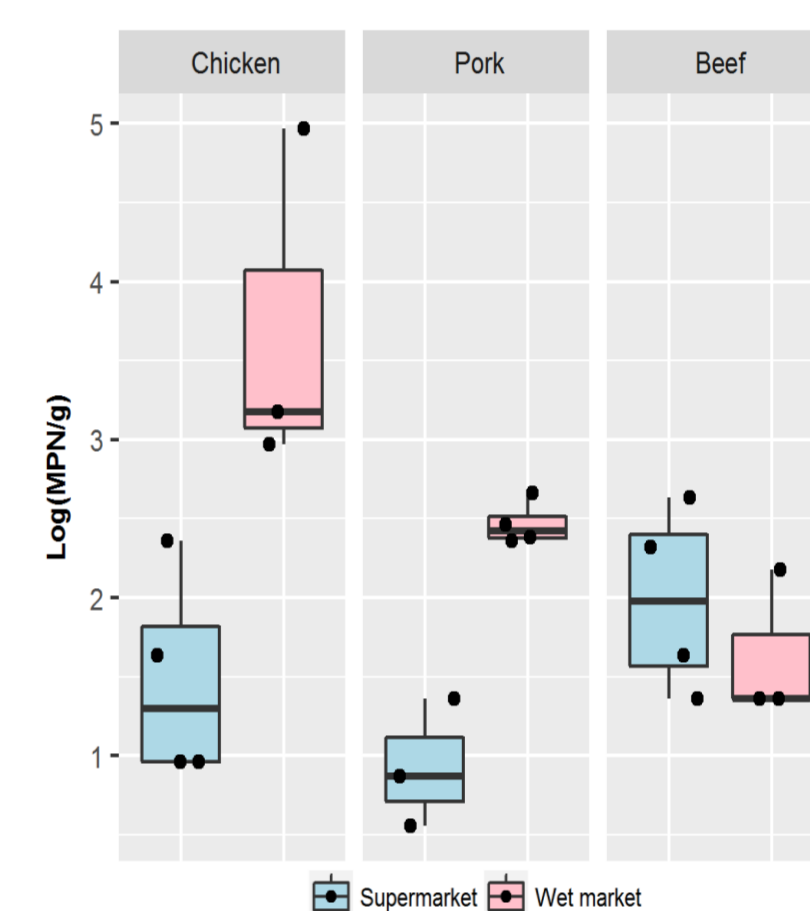
Antimicrobial residues

| | | Chicken | Pork | Beef | Total |
|--------------------------|-----------|---------------|--------------|---------------|---------------|
| Wet markets | Hanoi | 0/20 | 1/20 | 0/20 | 1/60 |
| | HCMC | 2/20 | 0/22 | 1/22 | 3/64 |
| | Dong Thap | 6/39 | 3/38 | 10/39 | 19/116 |
| Total wet markets | | 8/79 | 4/80 | 11/81 | 23/240 |
| Supermarkets | Hanoi | 1/20 | 0/21 | 0/19 | 1/60 |
| | HCMC | 1/19 | 1/19 | 0/15 | 2/53 |
| | Dong Thap | 0/1 | 0/2 | 0/1 | 0/4 |
| Total supermarket | | 2/40 | 1/42 | 0/35 | 3/117 |
| Total by species | | 10/119 | 5/122 | 11/116 | 26/357 |

- The highest proportion corresponded to beef (9.5%), followed by chicken (8.4%) and pork (4.1%) samples
- Meat samples purchased in wet markets had a higher prevalence of residues than those from supermarkets (9.6% vs. 2.6%, p=0.016)
- Sulfonamides, tetracyclines, and macrolides were detected in 3.1%, 2.8% and 2.0% of all samples

Quantification of NTS in meat products

- Chicken meat had the highest prevalence of NTS (71.8%), followed by pork (70.7%) and beef samples (62.2%)
- The overall median log MPN/g counts were 2.4, 2.4 and 1.6 for chicken, pork and beef samples, respectively.



Antimicrobial resistance of NTS isolates

| Class and antimicrobial | Chicken (n=37) | Pork (n=40) | Beef (n=36) | Total intermediate resistant (%) | Total fully resistant (%) |
|--|----------------|-------------|-------------|----------------------------------|---------------------------|
| Aminoglycosides | | | | | |
| Gentamicin | 0/10 | 0/10 | 0/10 | 0 (0%) | 0 (0%) |
| Amikacin | 0/10 | 0/10 | 0/10 | 0(0%) | 0 (0%) |
| Tobramycin | 4/11 | 1/10 | 1/10 | 6 (5.3%) | 1 (0.9%) |
| 3rd and 4th generation cephalosporins | | | | | |
| Cefotaxime | 0/15 | 0/10 | 0/10 | 0 (0%) | 5 (4.4%) |
| Ceftazidime | 0/15 | 0/10 | 0/10 | 0 (0%) | 5 (4.4%) |
| Cefixime | 0/15 | 0/10 | 0/10 | 0 (0%) | 5 (4.4%) |
| Ceftriaxone | 0/15 | 0/10 | 0/10 | 0 (0%) | 5 (4.4%) |
| Cefepime | 1/11 | 0/10 | 0/10 | 1 (0.9%) | 1 (0.9%) |
| Monobactams | | | | | |
| Aztreonam | 0/15 | 0/10 | 0/10 | 0 (0%) | 5(4.4%) |
| Penicillins | | | | | |
| Ampicillin | 0/22 | 0/23 | 0/11 | 0 (0%) | 56 (49.6%) |
| Ampicillin/sulbactam | 14/18 | 22/10 | 10/11 | 46 (40.7%) | 9 (8.0%) |
| Amoxicillin/clavulanic acid | 4/3 | 0/10 | 1/10 | 5(4.4%) | 3 (2.6%) |
| Ticarcillin | 1/21 | 0/23 | 0/11 | 1(0.9%) | 55 (48.7%) |
| Piperacillin | 0/22 | 0/23 | 0/11 | 0 (0%) | 56 (49.6%) |
| Piperacillin/tazobactam | 5/10 | 0/10 | 1/10 | 6 (5.3%) | 0 (0%) |
| Polymyxins | | | | | |
| Colistin | 0/10 | 0/11 | 0/10 | 0 (0%) | 1 (0.9%) |
| Quinolones | | | | | |
| Nalidixic acid | 0/20 | 0/12 | 0/16 | 0 (0%) | 28 (24.8%) |
| Ciprofloxacin | 19/18 | 38/12 | 32/14 | 89 (78.8%) | 24 (21.2%) |
| Ofloxacin | 10/26 | 26/14 | 24/11 | 60 (53.1%) | 51 (45.1%) |
| Levofloxacin | 18/17 | 12/13 | 14/13 | 44 (38.9%) | 23 (20.3%) |

- The overall prevalence of MDR among NTS isolates was 52.2% with the highest level corresponding to isolates from chicken meat (67.6%), followed by pork (55.0%) and beef (33.3%)

Conclusions

- Appropriate withdrawal periods should be strictly enforced after the administration of antimicrobials to ensure the safety of animal food for human consumption
- We recommend a review of slaughtering/hygiene procedures to limit cross-contamination with NTS, with particular attention to poultry wet markets.

References

1. Cuong NV et al (2016), EcoHealth 13, 490-498
2. Majowicz SE et al (2010), Clin. Infect. Dis. 50, 882-889
3. Pavic A et al (2009), J. Appl. Microbiol. 109, 25-34

Acknowledgements: This work was funded by the Wellcome Trust through an Intermediate Clinical Fellowship to Juan Carrique-Mas (Grant No. 110085/Z/15/Z). This work contains information extracted from the manuscript: 'Antimicrobial residues and resistance against critically important antimicrobials in non-typhoidal *Salmonella* from meat sold at wet markets and supermarkets in Vietnam' published in International Journal of Food Microbiology 2018