# STYRIAN RESISTANCE MONITORING PROGRAMME (REMOST) – THREE YEARS TREND IN ANTIMICROBIAL RESISTANCE

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## Introduction

The EU Council passed a resolution on antibiotic resistance entitled "A strategy against the microbial threat" on 8 June 1999. In the same year, the Department of Veterinary Administration (DVA) in Styria established a Resistance Monitoring Programme (REMOST) (KÖFER et al., 2002) modelled on the trend-setting Danish activities (AARESTRUP et al., 1998). In the REMOST programme the resistance behaviour of zoonotic pathogens (*Salmonella* spp., *Campylobacter* spp.) and indicator bacteria (*Enterococcus* spp., *E. coli)* isolated from slaughter pigs, cattle and broilers is tested on a continuous basis. Additionally, indicator bacteria in bulk milk samples from cows are also tested. The test results are published on an annual basis and are fed into a central database, which is linked to a geographical information system named VETGIS© Styria (FUCHS et al., 2001).

## Materials and Methods

The REMOST programme consists of a sampling system, which indicates where, how and when samples are to be taken, an analysis system for the continuous analysis of data and a catalogue of measures based on these modules. Isolation of the bacterial strains is done by streaking the material to be tested (faeces, meat, milk) on different agar media: *E. coli* (Coli IDAgar, Biomerieux No. 42017), *Enterococcus faecalis/faecium* (CATC medium, ÖNORM DIN 10106), *Salmonella enterica* (MSRV method), *Campylobacter jejuni/coli* (mCCDA). After biochemical verification of suspect colonies, the resistance behaviour is tested using the SENSITITRE® system, a commercially available MIC technique using dehydrated antimicrobials in microtitre wells. The wells were inoculated according to NCCLS guidelines using breakpoints recommended by NCCLS or DANMAP. During the investigation period (2001 – 2003) a total of 537 *Salmonella* spp., 1290 *Campylobacter* spp., 1294 *E. coli,* 1340 *Enterococcus* spp. from faecal specimen and 761 *Enterococcus faecalis,* 184 *E. coli* strains isolated from bulk milk samples were tested against 12 to 16 antibiotics.

## Results and Discussion

Faecal isolates of *Salmonella* spp. showed high resistance rates to streptomycin (62-73%) and tetracycline (19-50%). The quinolones nalidixic acid and ciprofloxacin produced different results. While the resistance rates of *Salmonella* spp. to nalidixic acid were in the 27-56% range not a single Salmonella isolate showed resistance to ciprofloxacin (Tab. 1).

*Campylobacter* spp. displayed considerably higher resistance rates than *Salmonella* spp. The situation for *C. jejuni* is of particular significance in this respect, since this pathogen is involved in approx. 90 % of Campylobacter induced human illnesses. As expected, *Campylobacter* spp. isolated from broilers showed higher resistance rates (CIP, ERY, TET) than strains from cattle (Fig. 1, 2).

The analysis of the resistance behaviour of *E. coli* from broilers and pig samples produced high resistance rates to streptomycin, tetracycline and spectinomycin (Fig. 3). The situation for isolates from cattle faeces and beef surfaces, in contrast, was much more favourable..

Tab. 1: Occurrence of resistance among *Salmonella* spp. from broilers, faeces

| | 2001 | | | 2002 | | | 2003 | | |
|---|---|---|---|---|---|---|---|---|---|
| | **n** | **% res** | **CI 95** | **n** | **% res** | **CI 95** | **n** | **% res** | **CI 95** |
| AMP | 74 | 16.2 | [9.6, 26.3] | 104 | 31.7 | [23.6, 41.2] | 48 | 29.2 | [18.3, 43.3] |
| AUG | 74 | 6.8 | [3, 14.9] | 104 | 6.7 | [3.3, 13.3] | 48 | 8.3 | [3.4, 19.6] |
| CHL | 74 | 6.8 | [3, 14.9] | 104 | 17.3 | [11.3, 25.7] | 48 | 12.5 | [5.9, 24.8] |
| GEN | 74 | 0.0 | [0, 4.8] | 104 | 1.0 | [0.2, 5.2] | 48 | 4.2 | [1.3, 14] |
| NAL | 74 | 27.0 | [18.2, 38.1] | 104 | 40.4 | [31.5, 50] | 48 | 56.3 | [42.2, 69.3] |
| NEO | 74 | 4.1 | [1.5, 11.2] | 104 | 15.4 | [9.7, 23.6] | 48 | 18.8 | [10.2, 32] |
| SPE | 74 | 5.4 | [2.2, 13.1] | 104 | 7.7 | [4, 14.5] | 48 | 16.7 | [8.8, 29.7] |
| STR | 74 | 62.2 | [50.7, 72.4] | 104 | 69.2 | [59.8, 77.3] | 48 | 72.9 | [58.9, 83.4] |
| TET | 74 | 18.9 | [11.6, 29.3] | 104 | 38.5 | [29.7, 48.1] | 48 | 47.9 | [34.4, 61.7] |
| TMP | 74 | 10.8 | [5.6, 19.9] | 104 | 5.8 | [2.7, 12] | 48 | 10.4 | [4.6, 22.2] |

CIP, COL, FFN, XNL < 3% resistant

**Legend:** AUG… amoxicillin+clavulanic acid, AMP … ampicillin, XNL … ceftiofur, CHL … chloramphenicol, CIP … ciprofloxacin, COL … colistin, FFN … florfenicol, GEN … gentamicin, NAL … nalidixic acid, NEO … neomycin, SPE … spectinomycin, STR … streptomycin, TET … tetracycline, TMP … trimethoprim

Fig. 1: Resistances among *C. jejuni* from broilers (n=327)

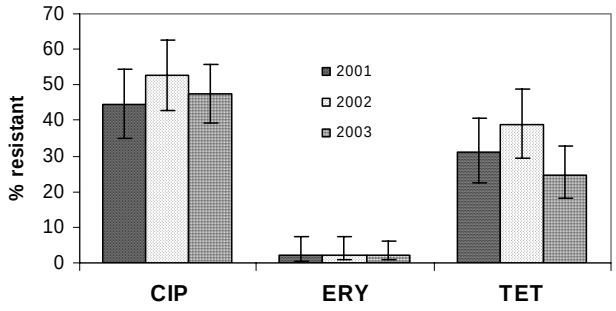



Fig. 2: Resistances among *C. jejuni* from cattle (n=228)

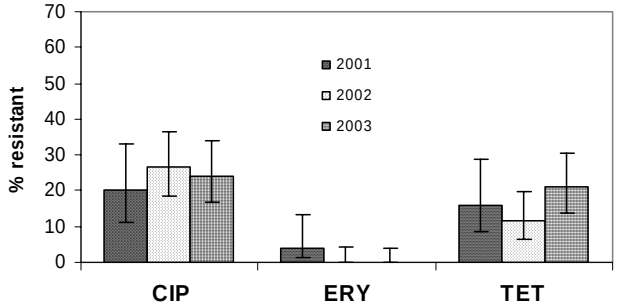



Fig. 3: Resistances among *E. coli* from pigs (n=428)

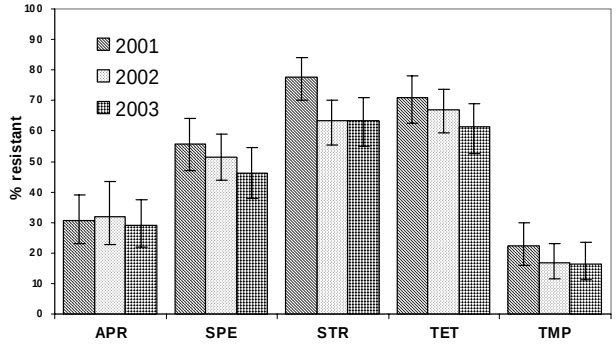
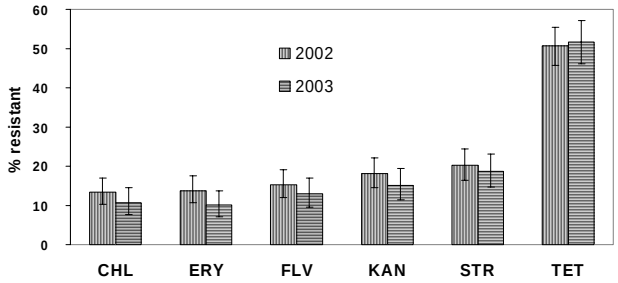



Fig. 4: Resistances among *E. faecalis*, bulk milk (n=761)




The resistance rates of *Enterococcus* spp. isolated from cattle faeces were also considerably below those obtained for poultry and pigs, as in the case of *E. coli*. The bacterial strains obtained from cattle revealed higher levels of resistance only to flavomycin, tetracycline and bacitracin. The poultry isolates showed very high rates of resistance to bacitracin, erythromycin, tetracycline and virginiamycin.

*Enterococcus* spp. isolates from cattle faeces also displayed a high level of resistance to flavomycin, whereas isolates from bulk milk samples showed a high level of resistance only to tetracycline (Fig. 4).

The results of our investigation of the resistance behaviour of indicator bacteria and zoonotic pathogens are comparable with data from other countries, like Denmark (DANMAP, 2002), Sweden (SVARM, 2003) or Norway (NORM/NORM-VET, 2002). In addition to the monitoring of antimicrobial resistance it will be necessary to collect valid data about the consumption of antibiotics and chemotherapeutics in livestock husbandry. The prudent use of antimicrobials in the production of food of animal origin according to the principles of Good Veterinary Practice (VAN MIERT, 1993) provides the basis for optimising veterinarian support in the management of farm animals.

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