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Spatial distribution of antibiotic-resistant genes in arable lands in Russia

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Antibiotics are widely used for the treatment and prevention of animal diseases. Furthermore, in animal husbandry antibiotics are often used as growth promoters. Many antibiotics used for veterinary purposes are weakly absorbed in the animal's gut. So, up to 90% of the administered antibiotics are excreted with manure and urine. Therefore application of manure as an organic fertilizer for arable lands leads to formation and spreading of antibiotic resistance among soil microbes. Another reason of such spreading is the horizontal transfer of genes encoding antibiotic resistance from manure to soil microflora. The level of antibiotic resistance genes pollution of soils has not been properly studied yet.
The objective of this study was to estimate the contamination of agricultural soils by antibiotic resistant genes. 30 samples of agricultural soils were selected around of Kazan city (Tatarstan Republic) with 1.3 Mio citizens. Since tetracycline is reported to be the most widespread veterinary antibiotic in Russia, we estimated the level of soil contamination by tet(X) gene encoding tetracycline decomposition in microbial cell. Real time PCR method with specific primers was used as a method of investigation.
Particle size type distribution of 20% of soil samples was estimated to be sandy loam, and 80% of soil samples – to silty loam. Content of dissoluble organic carbon ranged from 0.02 mg g -1 (sample 20) to 0.46 mg g -1 (sample 16). Respiration activity and microbial biomass of soils were estimated to be 0.80-5.28 CO_2 C mg g -1 h-1 and 263.51-935.77 μg kg – 1 respectively. The values presented are typical for soils of Tatarstan Republic. In terms of the antibiotic resistant gene content, all samples investigated contained tet(X) gene. Copy number of tet(X) gene ranged between 1.28*106 g –1 and 1.55*107 g –1 while 27% of the samples were highly contaminated, 43% of samples were middle contaminated and 27% of samples – weakly contaminated.¬¬