20. BfR-Forum Verbraucherschutz Bakteriophagen, Berlin, Deutschland
07. – 08. November 2019

Lactococcus lactis bacteriophages in raw milk samples – a unique and diverse phage world

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Raw milk has been reported as a critical source for virulent bacteriophages in dairies. During milk fermentation (i.e. for cheese production), *Lactococcus lactis* phages can accumulate resulting in severe fermentation problems. Members of *L. lactis* phage groups 936, c2 and P335 are the most common phages found in dairies. However, recent studies have shown that raw milk also contains phages of uncommon and “rare” phage groups.
In our recent 1-year monitoring study, 64 raw milk samples were regularly obtained from 7 dairies and analysed for the presence of *L. lactis* phages. In ca. 50% of these raw milk samples, phages could be detected after enrichment with a representative set of *L. lactis* (laboratory) strains. Phage titers in the original raw milk samples were low and rarely exceeded the detection limit of 10 plaque-forming units (pfu) per ml (maximum titer was $1x10^3$ pfu/ml). The raw milk phages could be divided into 8 morphologically distinct phage groups: P335 phages (i), novel (atypical) *L. lactis* P335 / *Streptococcus thermophilus* "hybrid" phages (ii), 1706-like phages (iii), 949 phages (iv), 936 phages (v), 1358 phages (vi), c2 phages (vii) and P087 phages (viii).
In conclusion, raw milk phage populations are significantly different from phage communities persisting in dairies. While 936 phages are clearly dominating in dairies, phages in raw milk are mainly representatives of uncommon phage groups rarely detected in dairy plants.