Chemiluminescence Method to Detect Lipid Oxidation in Milk and Cream Powder

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Lipid and protein oxidation is a limiting factor for the shelf-life of milk and cream powder. Thus early revealing of oxidative changes would help to avoid undesired quality problems. A new approach for the detection of lipid oxidation is chemiluminescence (CL), which was compared to sensory evaluation and gas chromatography-mass spectrometry (GC-MS). CL refers to luminescence based on a chemical reaction. During decay of peroxide radicals excited electrons relax into their thermodynamically preferred state which causes the emission of light. The amount of emitted photons is counted in a photomultiplier tube.

Roller dried whole milk powder was illuminated during 2, 14, 16, 18, 20 and 21 h to induce photooxidation. A trained panel (n= 13-18) tested the samples directly after the treatment performing triangle tests with treated versus untreated samples. For CL analysis 100 mg of pelletized milk powder was placed in the chemiluminescence instrument (ACL Instruments) and gradually heated from room temperature to 180°C (heating rate 0.5°C / min, N_2 gas flow), while counting the emitted photons.

Already after 2 hours of illumination the CL signal differed from reference sample, whereas for sensory evaluation a significant difference was determined only after 18 h of treatment. With longer treatment time the emission of photons started earlier and the total amount of emitted photons increased. An additional test with spray dried cream powder (illumination for 0, 1, 2, 3, 5 and 11 days) showed clear differences in CL signal already after 1 day of illumination. GC-MS results showed higher quantities of Butanal, Pentanal, Methylbutenon, Hexanal, Heptanal, Octanal and Heptenal for treated samples (5d) compared to untreated sample and thus confirmed oxidative changes of lipids.

The new CL method allowed to detect lipid oxidation in an early stage as CL detects primary oxidation products (hydroperoxides) whereas the panelists perceive odour active secondary oxidation products. Results were reproducible and sample preparation is very simple. Results still have to be confirmed and compared to additional methods but chemiluminescence method seems to have a great potential for early detection of quality loss of milk powder and could be used for quality control.