This study aimed at unravelling the antioxidative capacity of low molecular weight compounds (LMWC) (peptides, amino acids and phenolic acids) present in salt brines from the marinated herring production. Brines were fractionated into <10 kDa fractions using dialysis and further into 94 fractions using size exclusion chromatography. All samples were analysed for protein, total phenolic content (TPC) and antioxidant activities. Protein-enriched samples were pooled (P1, P2 and P3) and analysed for phenolic acids, total amino acids and peptide/protein sequence using advanced mass spectrometry. All salt brines contain LMWC holding ABTS-radical scavenging activity, reducing power and iron chelating activity. Generally, a strong correlation between TPC and ABTS-radical scavenging was found. In contrast, reducing power and iron chelating activity seemed to be caused by peptides. Protein/peptide sequencing revealed 1 kDa peptides with the presence of HDF motif which could be responsible for some of the antioxidant capacity observed in marinated herring salt brine.