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**Madsen, Jan Busk; Nikogeorgos, Nikolaos; Abou Hachem, Maher ; Svensson, Birte; Lee, Seunghwan**

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# Biotribological properties of bovine submaxillary mucin (BSM) at the hydrophobic interface

JB Madsen[1], N Nikogeorgos[1], MA Hachem[2], B Svensson[2], S Lee[1]

*[1] Department of Mechanical Engineering, Technical University of Denmark, DK-2800, Kgs. Lyngby, Denmark [2] Department of Systems Biology, Enzyme and Protein Chemistry, Technical University of Denmark, DK-2800, Kgs. Lyngby, Denmark. [*]Corresponding author: seele@mek.dtu.dk*

**INTRODUCTION:** The macromolecule mucin is the major constituent of the mucous secretions that coat epithelial surfaces exposed to the outside in animals. The primary function of mucins and mucous gels is to provide protection to epithelial surfaces from invasive microbes and physical insults by forming a lubricating layer [1]. 50-80% of the molecular weight of mucin consists of post-translational N- and O-linked glycosidic modifications. The ability of the glycosylations to retain water at the epithelial surface facilitates lubrication [2,3]. N- and C-terminal interactions and also entanglement of the glycosidic modifications lead to a viscoelastic material that offers excellent lubrication properties. In this work, the influence of purification on the tribological properties of commercially available Bovine Submaxillary Mucin (BSM) was investigated. Furthermore, chemical and enzymatic decomposition of BSM was performed so as to assess the impact on lubricity by overall structural degradation or removal of specific molecular species from the macromolecule.

**METHODS:** Anion exchange chromatography was employed to purify BSM. A full description can be found in J.B. Madsen et al. (2013, in press) [4]. Purified BSM was proteolytically degraded by select proteases. Deglycosylation was carried out either enzymatically or via β-elimination. Adsorption behavior was investigated by optical waveguide lightmode spectroscopy (OWLS). Biotribological properties of the various states of BSM were investigated by pin-on-disc tribometry (PoD) and atomic force microscopy (AFM) on PDMS surfaces.

**RESULTS:** OWLS studies have shown the adsorbed masses of ar-BSM and ae-BSM on PDMS surface are 161 and 46 $ng/cm^2$, respectively. PoD revealed slight, yet consistently higher COF for ar-BSM (in the range of 0.04 to 0.09) than ae-BSM (0.004 to 0.01) at the sliding contact of PDMS within the speed range of 1 to 100 mm/s (1 Newton load) in neutral aqueous solution.

**DISCUSSION & CONCLUSIONS:** Superior lubricity of ae-BSM compared to ar-BSM, despite inferior adsorbed mass can be caused by competitive adsorption of non-mucinous, less slippery components in ar-BSM. Further, it is also possible that non-mucinous components in ar-BSM might have altered the conformation of ae-BSM at the surface. Biotribological properties of chemically and enzymatically decomposed BSM were also studied in parallel with surface adsorption studies, which were not simply correlated with each other. Statistical validation is firstly required, and a further understanding on the compositional and conformational changes of BSM both in bulk and at the surface is required. This study confirms the current understanding of BSM as an amphiphilic macromolecule with regards to surface adsorption and its lubrication properties in relation to a hydrophobic surface. The surface adsorption behavior of BSM could be assigned mainly to the unglycosylated N- and C-terminal regions, while the lubricity could be ascribed to the glycosylated region of the macromolecule.

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