

# FOOD GRADE BOGER FLUIDS FOR SENSORY STUDIES

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## ABSTRACT:

The effect of shear viscosity on taste and mouthfeel perception has been extensively studied; however, the effect of extensional viscosity on sensory perception has been mostly neglected. This may be important as in-mouth processing is complex and probably best described as a superposition of shear and extensional flow characteristics. Fluid mechanics researchers interested in separating elastic effects from viscous effects use Boger fluids and this approach was adopted here to investigate the effect of fluid elasticity on sensory perception. For the first time, two food grade Boger fluids based on glucose syrup and aqueous solutions of maltodextrin as solvents and xanthan gum as high molecular weight polymer were formulated. The elasticity of the Boger fluids was characterised in rotational shear rheometry, in a filament break-up device and in micro-contraction flow. Saltiness perception and mouthfeel of the Boger fluids and samples corresponding to the respective solvent were analysed. Surprisingly, there were no significant differences. Hypotheses attributing this finding to the intrinsic properties of the samples are discussed. A major study would be required to gain in-depth understanding of the sensory properties of these fluids as their flow properties are very different from typical liquid foods.

## ZUSAMMENFASSUNG:

Der Effekt von Scherviskosität auf Geschmackempfinden und Mundgefühl ist vielfach untersucht worden. Dehnviskosität, dahingegen, wurde in diesem Zusammenhang bislang so gut wie nicht beachtet. Dies obwohl Fließvorgänge während der Nahrungsverarbeitung im Mund komplex sind und daher am besten als eine Superposition von Scher- und Dehnströmung beschrieben werden. Elastische Eigenschaften beeinflussen Verhalten in Dehnströmungen maßgeblich. Der klassische experimentelle Ansatz den Effekt von elastischen Materialeigenschaften und viskosen Effekten zu trennen Boger-Flüssigkeiten als Modellfluide einzusetzen. Dieser Ansatz wurde hier eingesetzt um den Effekt von Fluidelastizität auf sensorische Eigenschaften von flüssigen Lebensmitteln zu untersuchen: Salzigkeit und Mundgefühl. Zum ersten Mal wurden zwei lebensmittelgerechte Boger-Flüssigkeiten entwickelt. Glukosesirup und Maltodextrinlösungen wurden als Lösungsmittel und Xanthan als hochmolekulares Polymer eingesetzt. Die elastischen Eigenschaften wurden im Scherrheometer, im Dehnrheometer und in Mikrokanalströmungen charakterisiert. Salzigkeit und Mundgefühl der Boger-Flüssigkeiten und der entsprechenden nicht elastischen Solvents wurden untersucht und überraschenderweise wurden keine deutlichen Unterschiede gefunden. Hypothesen die diese Beobachtungen auf die Flüssigkeitseigenschaften zurückführen sind diskutiert. Um einen Einblick in das sensorische Verhalten dieser Flüssigkeiten zu erhalten müsste eine größere Studie durchgeführt werden da deren Fließigenschaften sehr verschieden von denen üblicher fließfähiger Lebensmittel sind.

## RÉSUMÉ:

L'effet de la viscosité de cisaillement sur la perception des goûts et de la texture pour les produits semi-liquides a fait l'objet de nombreuses recherches. En revanche, l'effet de la viscosité extensionnelle sur la perception sensorielle a été très peu étudié, malgré le fait que la manipulation des aliments en bouche soit complexe et résulte vraisemblablement d'une superposition d'écoulement extensionnel et de cisaillement. Les fluides de Boger ont été utilisés par le passé dans de nombreux travaux ayant pour objectif de dissocier les composantes élastiques et visqueuses des fluides complexes (non-Newtoniens) et une approche similaire a été choisie ici pour étudier l'effet de la viscosité extensionnelle sur la perception sensorielle des produits semi-liquides en bouche. Pour la première fois, deux fluides de Boger comestibles ont été formulés à partir de sirop de glucose et de solution de maltodextrines comme solvant, avec de la gomme xanthan comme polymère de haut poids moléculaire. L'élasticité de ces fluides a été caractérisée en cisaillement et en extension grâce à un rhéomètre extensionnel à rupture de capillaire et à l'étude de l'écoulement dans des canaux de taille micrométrique (microfluidique) comportant une contraction. La perception sensorielle du goût salé et de la texture des fluides de Boger a été

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## 4 CONCLUSIONS

In this research two food grade Boger fluids based on glucose syrup and maltodextrin solution as solvent and xanthan gum as the high molecular weight polymer were designed. Their shear viscosity was almost constant with variation being within the range reported in literature for 'technical' Boger fluids. The addition of xanthan gum to the viscous solvent imparted elastic properties as identified by development of a first normal stress difference in shear, values of the Trouton ratio of larger than three calculated from filament break-up experiments, and lastly, a pressure drop fingerprint in the micro-contraction flow experiment characteristic for elastic fluids. Results of sensory experiments did not reveal any saltiness or mouthfeel differences between Boger fluids and inelastic reference fluids. It seems that Boger fluids are too complex for saltiness perception studies. In particular the high viscosity, unusual for salty semi-liquid food products, and the sweet taste, imparted by the chosen Newtonian solvents, appeared to have impaired the saltiness sensitivity of panellists. Therefore, it is suggested that an alternative approach be adopted to elucidate the effect of fluid elasticity on saltiness perception. Such an approach would involve the use of comparatively low viscosity polysaccharide solutions which will require, as an initial step, characterisation of their viscoelastic behaviour in large deformation flows. On the other hand edible Boger fluids, as formulated in the present work, may still be useful to assess the relationship between fluid elasticity and sweetness as well as mouthfeel. Indeed, the samples are intrinsically sweet and sweet viscous liquids are commonly encountered as food; honey being a good example. Also, addition of a congruent flavour such as strawberry aroma may improve the pleasantness of the samples.

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