



## **Study Summary**

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**Influence of frequency and amplitude  
on the mucus viscoelasticity of the  
novel mechano-acoustic Frequencer®**

June 13, 2019

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## Purpose of the study

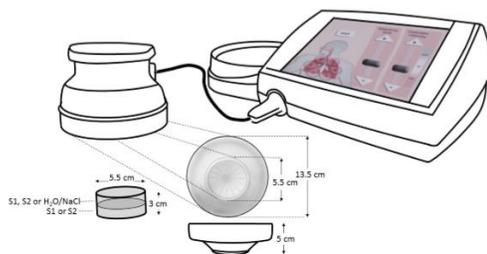
To study a mechano-acoustic treatment device to help patients expectorate excess mucus in a non-invasive and enervating way. It was important to understand how the mucus rheology and hydration changes depending on the frequency and amplitude of the acoustical waves delivered to the sample using the Frequencer®.

## Background

Cystic Fibrosis (CF) is an inherited genetic disease affecting 1/3200 Caucasians that is characterized by the buildup of thick, sticky mucus that can damage many organs, especially the lungs (1). CF patients live with mucus in their lungs that is dehydrated and viscous, making it harder to expectorate. This is namely caused by an absence or malfunction of the gene that encodes for the CFTR protein, responsible for keeping the mucous hydrated by maintaining the water and ion homeostasis across the respiratory epithelia.(2) Mucous is composed of water, protein, carbohydrates, lipids and antimicrobial factors (3). Mucins are the main constituents of mucous and are responsible for its rheology (4). Healthy humans have a mucin content of 1% by weight where individuals with CF have a mucin content of about 4% by weight (5).



## Methods



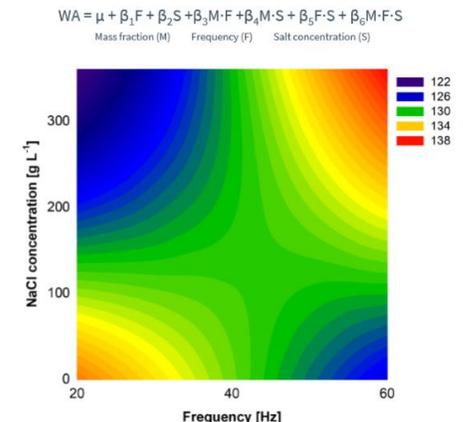
Synthetic mucin solutions were prepared in vitro using porcine stomach mucin to recreate the 1% by weight healthy condition (S1) and the 4% by weight CF patient condition (S2). 48 experiments were conducted by adding mucus to a plastic cylindrical reactor with an external diameter corresponding to that of the opening of the Frequencer® adaptor. Four conditions were tested, mucus on its own, mucous combined with water, mucus combined with NaCl (0.5 g L<sup>-1</sup>) and lastly mucus combined with Brine. Multiple parameters on the Frequencer® were set in order to determine which condition, frequency (20Hz, 40Hz, 60Hz) and intensity (50% and 100%) would lead to optimal mucus rehydration and rheology.

## Results

The Frequencer® proved to be effective in the homogenization of synthetic mucin salutation in vitro in 20 minutes. A working frequency of 40 Hz and a 0.5g L<sup>-1</sup> NaCl solution are the optimal operative parameters to obtain partial rehydration of mucus, regardless of the intensity selected, this is consistent with what is reported by patients using the device.

## Conclusion

The optimal frequency for mucus rehydration was found to be 40Hz, regardless of the intensity selected and of NaCl concentration.



## References

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