Sonication effect on foam properties of egg white

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Introduction

Egg white possesses multiple functional properties, such as foaming, gelling and emulsifying and widely used in the food industry. Due to the excellent foaming properties it is a common ingredient in cakes and desserts. To provide a desirable texture and quality in such food products it is crucial for the food industry to improve the foaming properties of egg white. The foaming formation is mostly influenced by the structure of the contained proteins. During the industrial thermal processes these proteins can be altered, leading to undesirable functionality loss. Using ultrasound treatment offers an application for the food industry to modify the functional properties of food proteins in a more favorable direction.

There are studies dealing with the topic of the effect of ultrasound treatment on foaming properties of egg white, but there are some conflicting observations.

The purpose of this study is to inspect the sonication effect on the foaming properties of egg white to take a stand on this topic and determine the importance of the treatment parameters on these properties changes, that may give an explanation of the cause of the previous diverse findings.

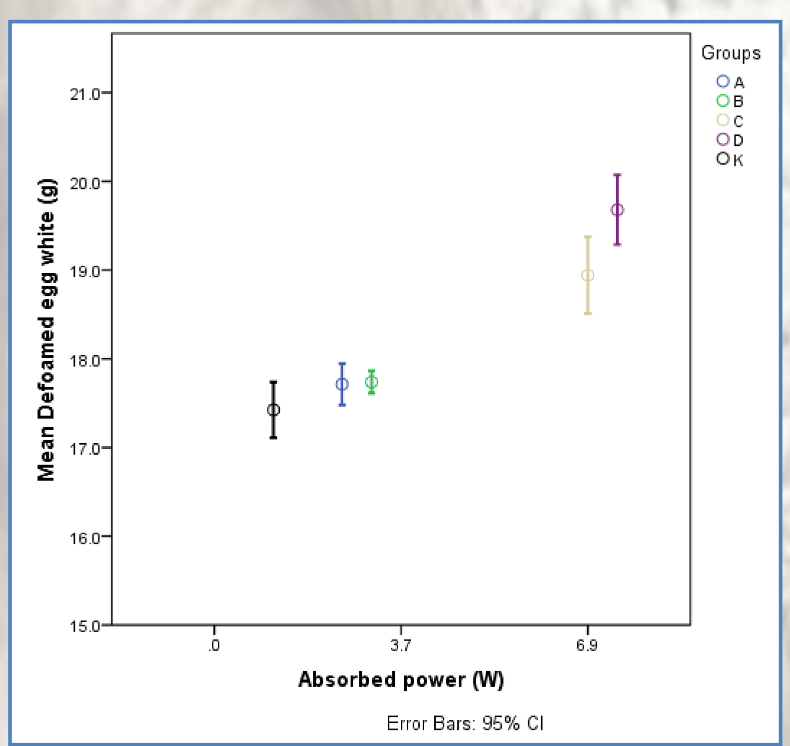
Ultrasound treatment

To determine the effect of ultrasound treatment on foaming properties an ultrasonic bath (HBM Machines, Netherlands) was used. The equipment is capable of delivering up to 300 W of power at 20/40 kHz frequency. Depending on the applied treatment parameters the samples were separated according to the table below. After homogenization 180 ml of egg white was poured into 200 ml glass container. To ensure sonic conductivity the ultrasonic equipment was filled up with 16 L of tap water and the containers were put into this media. In order to avoid thermal impact on foaming properties an external cooling system was built to keep the temperature at 18°C during the whole treatment. Untreated samples were subjected to the same temperature conditions as the sonicated ones.

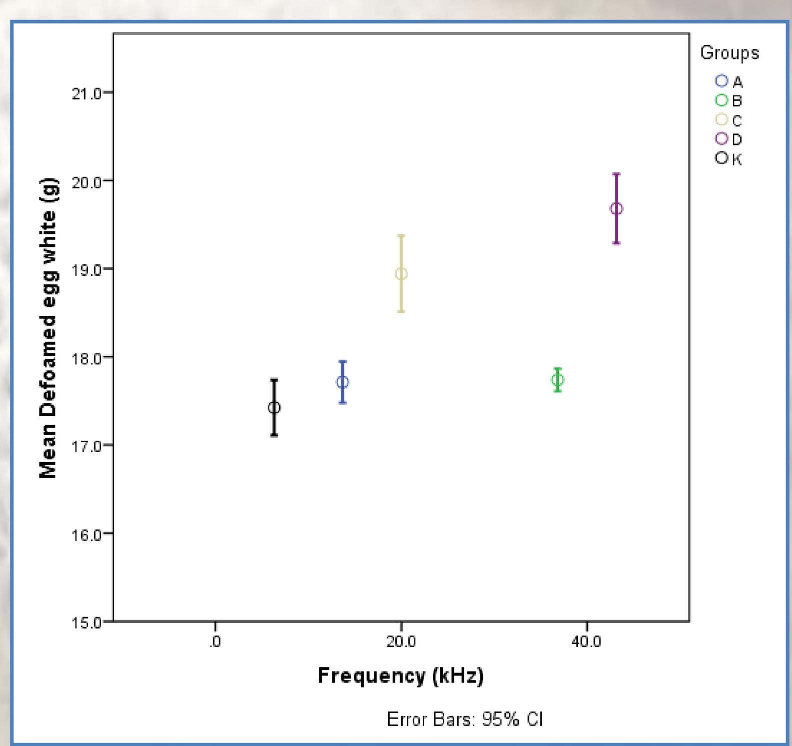
Group	Frequency	Power	Duration
A	20 kHz	180 W	30, 45, 60 min
B	40 kHz	180 W	30, 45, 60 min
C	20 kHz	300 W	30, 45, 60 min
D	40 kHz	300 W	30, 45, 60 min
K	-	-	-

Sample groups by treatment parameters

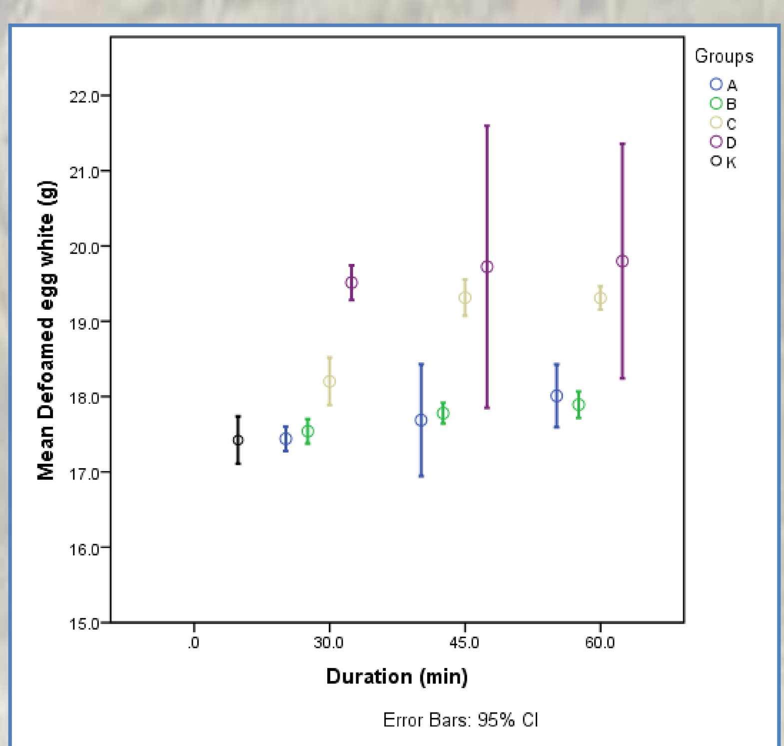
a.)



b.)



c.)



Defoamed egg white (g) by absorbed power (a), frequency (b) and duration of the treatment (c) (A - 3.7 W absorbed power and 20 kHz frequency; B - 3.7 W absorbed power and 40 kHz frequency; C – 6.9 W absorbed power and 20 kHz frequency; D – 6.9 W absorbed power and 40 kHz frequency

Materials and Methods

Egg white samples

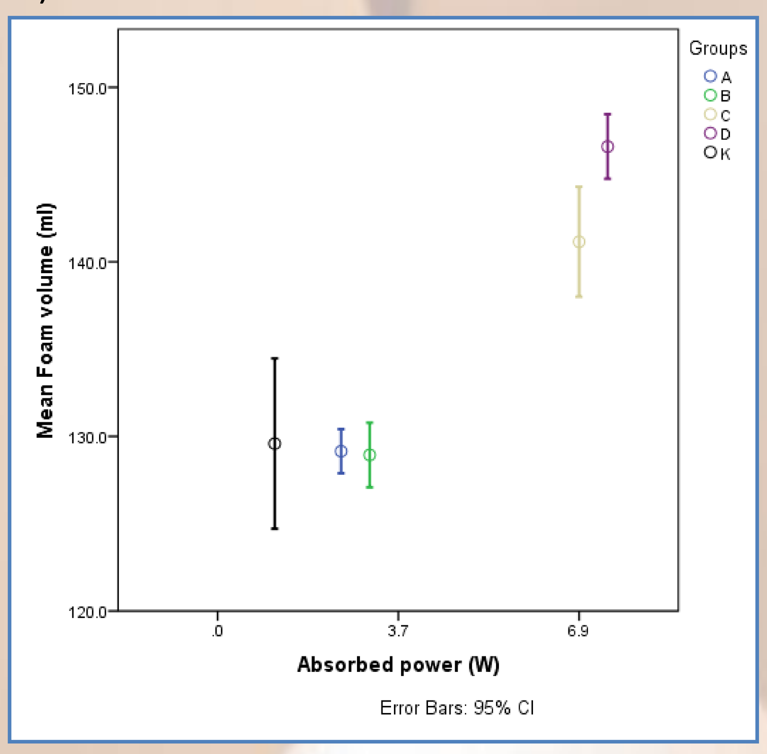
A total of 7 liters of egg white were used for this experiment, provided by Capriovus Kft. (Szigetcsép, Hungary). The product was made of „A" classified (589/2008/EC regulation) homogenized and pasteurised fresh hen eggs. The egg white samples were stored at 0-4 °C in 1 L jugs before the measurement.

For assessing foaming properties, foam capacity and foam stability were measured.

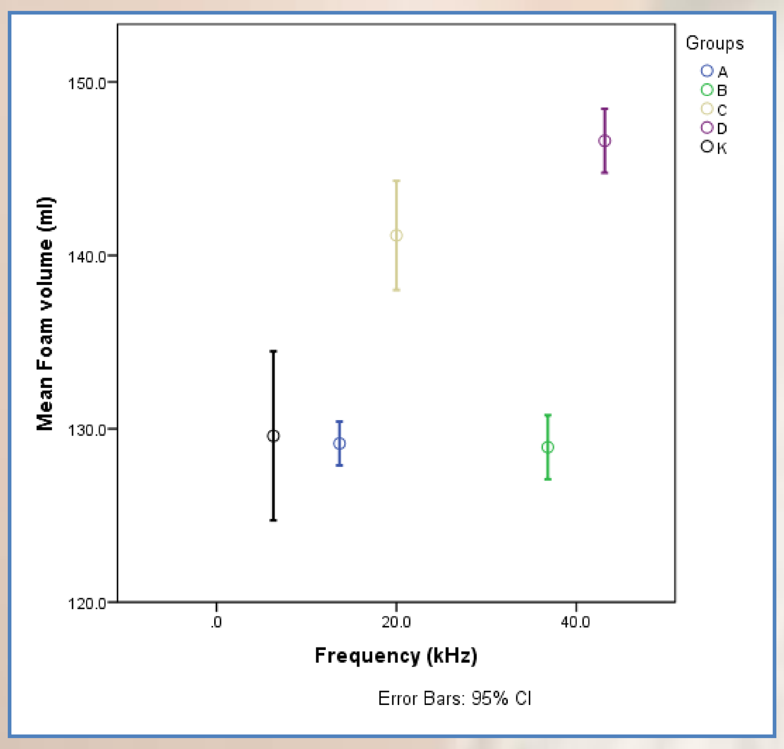
Data analysis

In order to evaluate the effect of each treatment parameter on foam capacity and foam stability Kruskal-Wallis test was used. The observed data was not normally distributed and this test is a non parametric test that can be used if the data does not have normal distribution. The null hypothesis of this test is that the median of the studied groups are the same. In other words, it can be tested whether there is a difference between the medians of the populations belonging to each compared groups.

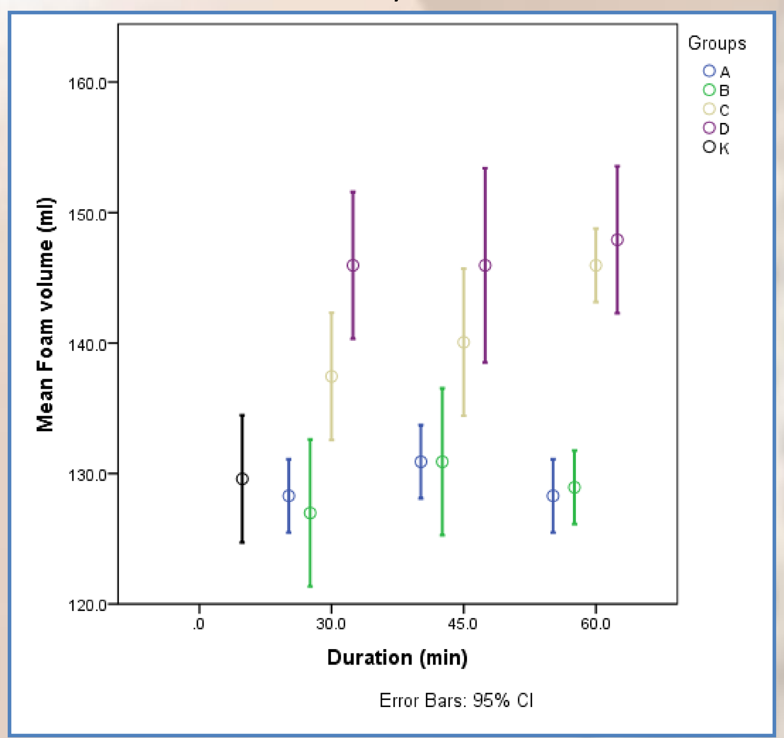
a.)



b.)



c.)



Foam volume (ml) by absorbed power (a), frequency (b) and duration of the treatment (c). (A - 3.7 W absorbed power and 20 kHz frequency; B - 3.7 W absorbed power and 40 kHz frequency; C – 6.9 W absorbed power and 20 kHz frequency; D – 6.9 W absorbed power and 40 kHz frequency)

Conclusion

Foam capacity had been enhanced due to the sonication and a 25 % increase was observed in the case of 40 kHz and 300 W treatment with 60 minutes duration compared to control group samples. The foam stability however, decreased. That may be caused by the changes in zeta potencial of the egg white. In both cases the power of the sonication had the most impact on the changes and the frequency and duration had only affected the foam stability significantly.

The results supplied information about the applicability of ultrasound treatment in foam formation to achieve a better foam structure in the field of food processes.

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