

Effects of ultrasound on the properties of pork protein and fat emulsions

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Introduction: Myofibrillar protein (MP) and fat emulsion largely determine the quality of emulsified meat products (Chevance & Farmer, 1998; Zheng et al., 2021). Using high-intensity ultrasound to prepare food emulsion is gradually arousing the interest of researchers. However, ultrasound-assisted emulsification (UAE) was mostly applied to prepare milk or plant protein stabilized vegetable oil emulsions. This work was designed to study the influences of UAE on the emulsifying properties, rheological properties, particle size and confocal laser scanning microscope (CLSM) images of MP-pork fat emulsions.

Materials and methods:

1 UAE treatment

The protein concentration (extracted from porcine longissimus dorsi muscle) was 30 g L⁻¹ and fat (extracted from pork backfat) contents were 2, 3, 6, 30, 150, 300 and 450 mL L⁻¹ (protein/fat ratios were 15:1, 10:1, 5:1, 1:1, 1:5, 1:10 and 1:15) according to our previous study (Zhou, Zhang, Lorenzo, & Zhang, 2021). UAE was carried out at 12.38 W cm⁻² for 6 min (1 s on, 3 s off) with a 20 kHz ultrasound processor and a 6 mm (diameter) titanium (Wang, Yang, Tang, Ni, & Zhou, 2017).

2 Determination of emulsifying properties

The determination of emulsifying activity index (EAI) and emulsifying stability index (ESI) of MP accorded the method as described by Pearce and Kinsella (1978).

3 Determination of rheological properties

A rotational rheometer was used to determine the viscosity coefficients (k) and the flow index (n) of MP-pork fat emulsions.

4 Determination of droplet sizes

The droplets sizes were measured by a Malvern 3000.

5 CLSM images

A CLSM was used to obtain CLSM images.

Results:

1 Emulsifying properties

UAE treatment provided the samples with a more pronounced emulsion-white appearance. With the increase of fat volumes, the EAI values significantly increased for both non-ultrasound and ultrasound groups. The value of EAI significantly increased after UAE especially for 1:10 groups. The ESI also significantly increased for emulsions after UAE treatment.

2 Rheological properties

UAE significantly increased the n values of all emulsions. UAE firstly caused a significant increase and then a significant decrease in the k values as the protein/fat ratios decreased.

3 Droplet sizes

UAE decreased the values of D10, D50, D3,2 and D4,3 of all emulsions, especially for the ratio at 1:10 which D3,2 value decreased from 130.2 to 1.7 µm. The influences of protein/fat ratios on non-sonicated and sonicated emulsion were different.

4 CLSM images

As for sonicated samples, CLSM images indicated that the most proteins did not participate in the formation of protein-coated emulsion when the protein/fat ratio was higher than 1:10, while the most proteins participated in the formation of emulsions and formed small emulsion droplets when the protein/fat ratio was at 1:10.

Conclusions: UAE decreased the sizes of MP and pork fat emulsion droplets. UAE could enhance the EAI and ESI of MP under different fat conditions, especially for the protein/fat at 1: 10 and 1:15.

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Literature:

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