EFFECT OF HIGH POWER ULTRASOUND ON DROPLET SIZE AND STABILITY OF O/W OVALBUMIN AND FISH OIL EMULSIONS

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Introduction. Even though high power ultrasound has recently become an efficient tool for emulsion formation, including particle size reduction (1) scattered information is available on ultrasound influence on droplet size of emulsions prepared by proteins and marine oil.
The objective of this work was to study the effect of ultrasound intensity (amplitude) on mean droplet size and stability of o/w emulsions, made of grade II ovalbumin solution as continuous phase, and fish or corn oil as dispersed phase.

Methods. Coarse o/w emulsions were prepared by dispersing fish or corn oil (9.3 %) into a protein solution (10.7 mg/mL), using high speed homogenization. The homogenized emulsions were subjected to high power ultrasound by an ultrasonic horn (2); the effect of varying ultrasound amplitude (30, 50, 70%) on mean droplet size and emulsion stability stored at 37 ºC were evaluated by Sauter mean diameter ($d_{3,2}$, μm) (3) using a Mastersizer micro instrument. Data were subjected to one-way ANOVA; significant differences were established with a P (<0.05).

Results. Mean droplet sizes of coarse emulsions prepared with fish ($d_{3,2}$= 5.04 μm) or corn oil ($d_{3,2}$= 5.45 μm) were significantly reduced (P<0.05) when applying high power ultrasound (4). Emulsion $d_{3,2}$ (μm) decreased with increasing ultrasound amplitude (Figure 1). However, fish oil emulsions treated with ultrasound produced smaller droplet sizes, possibly because partially unfolded ovalbumin had extender interactions with long chain polyunsaturated fatty acids in fish oil during the interface formation, leading to reducing oil droplet size.
Regardless the oil used as dispersed phase (fish or corn oil) ultrasound amplitude: 50 or 70 %, enhanced stability of o/w emulsions stored at 37 ºC, due to no significant differences (P>0.05) were found in mean droplet size for up to 5 days (Table 1).

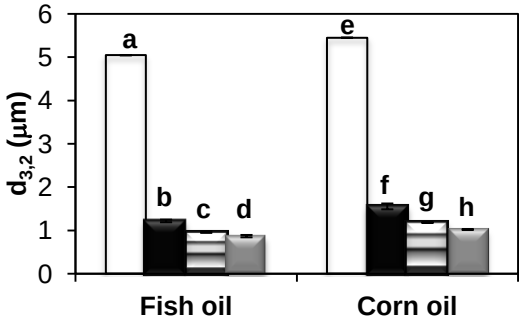

Fig.1 Mean droplet size ($d_{3,2}$, μm) of coarse o/w emulsions without sonication (white) and sonicated using ultrasound amplitude: 30 % (black), 50 % (stripes) or 70 % (grey). [a-h] Different letters indicate significant differences (P<0.05) in $d_{3,2}$ (μm).

Table 1. Sauter mean diameter ($d_{3,2}$, μm) of o/w emulsions stored at 37 ºC. [a-g]Different letters indicate significant differences (P<0.05) in $d_{3,2}$(μm).

Storage time (h)	Ultrasound amplitude (%)					
	Ovalbumin-fish oil			Ovalbumin-corn oil		
	30	50	70	30	50	70
		$d_{3,2}$ (μm)			$d_{3,2}$ (μm)	
0	1.22a	0.96c	0.87d	1.55e	1.18f	1.02g
24	1.65b	0.98c	0.88d	-	1.17f	1.08g
72	-	0.94c	0.83d	-	1.17f	1.05g
120	-	0.94c	0.81d	-	1.15f	1.04g

Conclusions. Emulsion stability was significantly (P<0.05) increased when 50 or 70% ultrasound amplitude was applied, shown by reduction in oil droplet size, in ovalbumin and fish or corn oil emulsions. However fish oil produced smaller droplets than corn oil.

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