

Preservation of liquid whole egg with the combination of heat treatment, high hydrostatic pressure treatment and salt

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Introduction

Eggs are usually marketed to consumers as shelled eggs, but liquid egg products, such as liquid whole egg (LWE), liquid egg yolk and liquid egg white are generally preferred for industrial usage (De Jesús et al., 2013). Shelf life of these products can be prolonged by high hydrostatic pressure (HHP) treatment, which is a non-thermal technology (Tóth et al., 2017). LWE can be treated by a pressure of 350 MPa for 5 minutes without significant changes in the viscosity (Monfort et al., 2012).

Materials and methods

Freshly produced salted (0,6 %) pasteurized (66 °C, 5 min) LWE was received from Capriovus Ltd. It was treated by high hydrostatic pressure of 350 MPa for 5 minutes (RESATO FPU 100-200). Samples were subjected to a 4-week storage experiment. We defined total plate count and the number of *Enterobacteriaceae* with plate counting method ones a week. Samples were accepted if their total number of bacteria did not reach 10⁵ CFU/g and the number of *Enterobacteriaceae* was less than 10² CFU/g according to european and hungarian regulations (Anonymous, 1998; Anonymous, 2005). Calorimetric properties of raw LWE and treated samples were examined by MicroDSC III instrument. Samples were heated up from 20°C to 95°C with a heating rate of 1.5°C/min, then cooled with a cooling rate of 3°C/min. Distilled water was used as reference material. Evaluation was carried out by Callisto Processing software. One-way ANOVA was performed by IBM SPSS Statistics 22.0 software ($\alpha=0,05$).

Results and discussion

Total plate count and the number of *Enterobacteriaceae* are shown in Table 1. Salted and heat treated LWE is not accepted on day 21 of the storage experiment based on the total plate count and the number of *Enterobacteriaceae* according to the Hungarian regulations. With HHP treatment, the sample was accepted on day 21, but not on day 28.

Table 2 shows the calorimetric properties of salted, heat treated LWE with and without HHP treatment. We can compare data with raw whole eggs calorimetric properties. Their denaturation temperature is significantly different from raw eggs in both cases, but the enthalpy of denaturation is just significantly different with HHP treatment.

Table 1: Evolution of total plate count and Enterobacteriaceae during the storing experiment

Sample	Storage time (days)							
	7		14		21		28	
	Log ₁₀ CFU	S.D.	Log ₁₀ CFU	S.D.	Log ₁₀ CFU	S.D.	Log ₁₀ CFU	S.D.
Total plate count								
LWE heat and salt	2.99	0.24	4.26	0.23	5.08 ^a	0.06	5.92 ^a	0.23
LWE heat, salt and HHP	1.97	0.11	3.15	0.08	4.34	0.07	5.28 ^a	0.17
Enterobacteriaceae								
LWE heat and salt	<1	-	2.14 ^b	0.12	2.71 ^b	0.11	3.32 ^b	0.06
LWE heat, salt and HHP	<1	-	<1	-	1.15	0.19	2.30 ^b	0.05

a: not accepted according to Anonymous, 2005 ($>10^3$); b: not accepted according to Anonymous, 1998 ($>10^2$)

Table 2: Denaturation temperature and enthalpy of raw LWE, heat treated (66 °C, 5 min) and salted (0,6 %) LWE and heat treated (66 °C, 5 min), HHP treated (350 MPa, 5 min) and salted (0,6 %) LWE

Sample	Denaturation temperature [°C]		Enthalpy of denaturation [J/g]	
	Mean	S.D.	Mean	S.D.
Raw LWE	75.44 ^a	0.083	1.786 ^a	0.073
Heat treatment+ salt	77.41 ^b	0.029	1.774 ^a	0.032
Heat treatment + HHP + salt	77.35 ^b	0.064	1.410 ^b	0.053

a,b,c: means with different letter are significantly different ($P<0.05$)

Conclusion

Our results show that HHP treatment of 350 MPa for 5 minutes prolongs the shelf life of salted pasteurized LWE about a week, but it can cause changes in calorimetric properties. In our next study we examine the changes in technofunctional properties.

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