UHT TREATMENT OF LIQUID EGG YOLK

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ABSTRACT

Starting from mechanical revolution, each day, new methods, new equipment have emerged. Today, the Ultra Heat Treatment (UHT) is one of the important technology that permits to the industry to reduce processing time while maintaining the same quality of the products. Egg and Egg products are known as heat-sensitive products, so the UHT enable us to preserve their qualities after a heat treatment.

Our aim is to study the effect of UHT treatment (approximately 67°C for 190 seconds) on the Liquid Egg Yolk (LEY). During twenty-one days, the color and viscosity were measured every seven days, we studied also the damage of protein using DSC (Differential Scanning Calorimetry).

On the 14th day of conversation, the reference samples (raw LEY) show a high microbial contamination that makes us stopped their tests while the treat samples retain their properties until the 21st day.

Keywords: UHT, egg, yolk…

Introduction

Poultry have become one of the major sources of human supplementary diet worldwide (Oladejo D. et *al*., 2015), due to the high-quality protein, essential vitamins, and minerals contains that are needed for a healthy diet (Zaheer K., 2015). So, it can be an excellent substrate for spoilage related microorganisms and food-borne pathogens so they are a highly perishable product even under refrigeration (Mendes de Souza P. et *al*., 2015). For this reasons, many conservations methods are used to extend the shelf-life of eggs products and preserve their properties as coating the eggs with petroleum jelly (Vaseline), immersions in

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limewater and water glass (Oladejo D. et *al.*, 2015). Coating of the egg shell takes a considerable duration of time to apply, but according to Mudannayka A.I et *al.*, 2016 coating with one of this materials (Beeswax, Gelatin and Aloe vera gel) can preserves the eggs for about 6 weeks of storage at 30°C. Nowadays, Industries prefers using the liquid egg products because it is easy to handle it. Microbiological safety of liquid products is mainly guaranteed by pasteurization (Lechevalier et al., 2017). Consequently, there is many standardization of the heat-treatment. The USDA requires liquid egg pasteurization (conventional processing) to be conducted on a critical temperature–time condition where egg protein coagulation may not occur. Minimum temperature and holding time requirements for the egg yolk is 60°C and 6.2 min. For the egg white and whole egg, minimum temperature and holding time requirements are 55.6°C and 6.2 min., 60°C and 3.5 min, respectively (Atılgan and Unluturk, 2008). While in France, only microbiological result are determined by regulation. Classic treatment use to pasteurize liquid whole eggs from 65 to 68°C for 2-5 min in order to ensure 5 to 6 decimal reduction of vegetative micro-organisms and especially *Salmonella Enteridis* and *Listeria monocytogenes* (Lechevalier et al., 2017). However, intensive heat treatments have been reported to alter the physical and functional proprieties of eggs by inducing formation or destruction of covalent bonds, which promotes changes in egg quality due to severe thermal protein denaturation (Llave, Fukuda, Fukuoka, Shibata-Ishiwatari, and Sakai, 2018). Therefore, our aims is to study the effect of heat treatment on the liquid egg yolk because when it is thermally treated the gel network formation can cause unpredictable structure changes through protein denaturation (Blume, Dietrich, Lilienthal, Ternes, and Drotleff, 2015).

Materials and Method

All of the samples (liquid egg yolk (LEY)) were supplied from production line of Capriovus Ltd (Szigetcsép, Hungary) directly after treatment with UHT Tubular pasteurizer. Samples were stored at a refrigeration temperature of 5°C in polyethylene bags for 21 days.

The ad of the additive (citric acid) was effected before the treatment.

Color measurements were done using the Minolta Chroma Meter CR-200, five points of the LEY bag were analyzed and the average value was calculated for all samples. Color-difference (ΔE*ab) was calculated using CIELAB system where L* is lightness (black point L*=0, white point: L*=100), a* is characteristic to red-green color (+a* red, -a* green), and b* is the blue yellow color (+b* yellow, -b* blue).

$$\Delta E^*ab = \sqrt{(\Delta a^*)^2 + (\Delta b^*)^2 + (\Delta L^*)^2}$$

For the protein denaturation, it was examined on Micro DSC III (differential scanning calorimeter). In each case approximately 778.5 ±5 mg of samples were taken, reference was distilled water. Speed of heating was 1.5 °C/min, temperature of measuring was 95 °C and speed of cooling was 1.5 °C/min, controlled by SetSoft2000. Callisto 7.6 software was used to evaluate DSC thermo-grams.

Viscosity tests were performed with Physica MCR 51 (Anton Paar Hungary) rotation viscometer, by a measurement system comprising CC 27 (cylinder with 27 mm) measuring body and ST 24 2V-2V-2D measuring head. Viscosity of sample solutions was tested with 600 1/s deformation rate at 15°C.

Results

Color

ΔE*ab allow to compare the color between the reference which in this case is the raw LEY and the sample which is the UHT LEY. The results are showed on *Table 1.* The major color difference is on the end of the storage period (8.35). While the minimum difference is registered on the first week of storage (4.92).

Table 1. ΔE*ab between raw and UHT LEY

	Day 0	Day 7	Day 14	Day 21
Raw LEY-UHT LEY	**7.29**	**4.92**	**7.99**	**8.35**

Protein Denaturation

In recent studies, the mechanism of egg yolk protein gelation has been investigated by different techniques (Blume, Dietrich, Lilienthal, Ternes, and Drotleff, 2015). The results of DSC is showed on Figure 1 and *Figure* 2. As the first thermograms shows the thermal denaturation of LEY during heating take place above 60°C just as the literature mentioned.

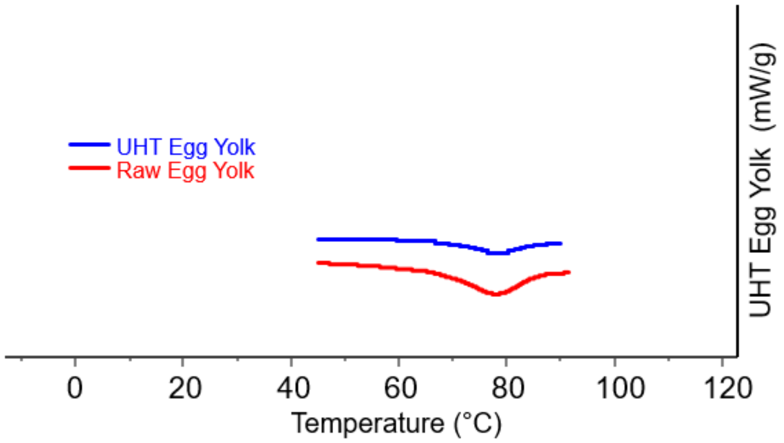

Figure 1. DSC results of egg yolk on the first day

We can notice that on the 1st day or the 21st day, the denaturation of UHT LEY protein take place on high temperature (78.28 and 76.52°C respectively). For the first day of storage, the denaturation of raw egg yolk protein started before the denaturation of UHT LEY protein.

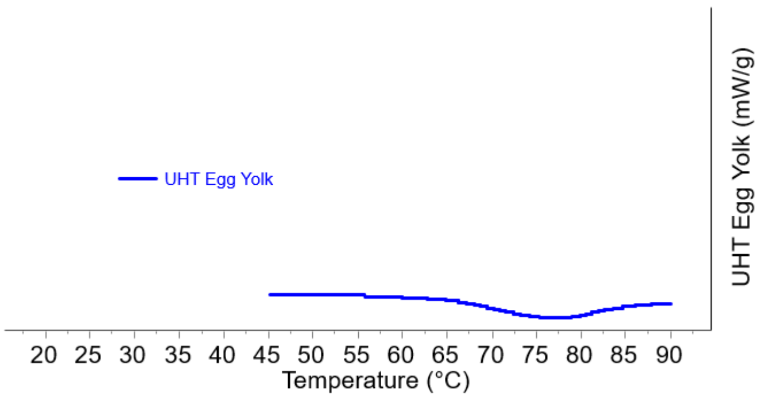

Figure 2. DSC results of egg yolk on the 21st day

On the last day of the study, the endothermic peak of UHT LEY decrease to 76.52°C. That's can be because of the microbiological contamination.

Viscosity Meseaurments

The results of viscosity is represented on the Figure 3 and 4. Table 2 show the Shear Stress (tau) and the viscosity (eta) on point number 10 on the first and fianl date of storage.

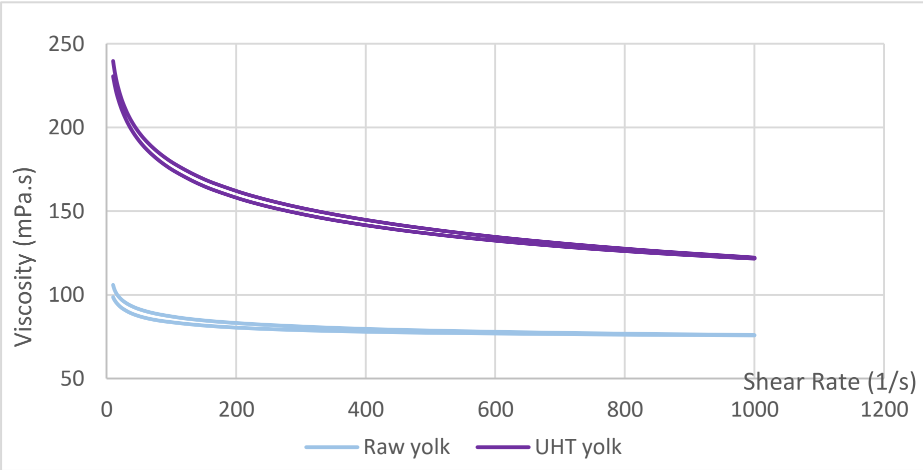

Figure 3. Rheological ghraph of LEY on the 1st day

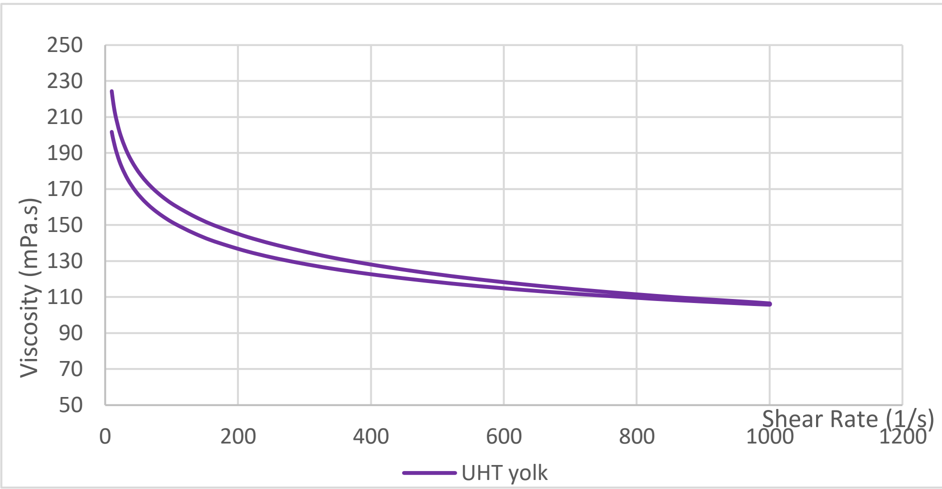

Figure 4. Rheological graph of LEY on 21st of storage

As Table 2. show there is a difference on the viscosity of the UHT and raw LEY. Even the curve look the same, but we can notice that the viscosity of the UHT LEY is much higher than the raw LEY. On the last day of storage we can observe that the viscosity of UHT LEY is decreased.

Table 2. Shear Rate, Tau and Eta of point 10 of LEY

		point	Shear Rate	Tau	Eta
Day 1	UHT LEY	10	39,8	8,07 ± 0,05	202,83 ± 1,40
	Raw LEY	10	39,8	3,70 ± 0,44	93,07 ± 11,25
Day 21	UHT LEY	10	39,8	7,39 ± 0,40	185,66 ± 10,05

Discussion

All the ΔE*ab is upper than 3, so the color difference between the samples is noticeable. We can suggest that the UHT treatment affect some nutrients responsible of coloration on the egg yolk.

Differential Scanning Calorimeter was used by (Cordobés, Partal, and Guerrero, 2004) in order to investigate thermal transition in egg yolk proteins and the provide information on the conversion from native to heat-denatured states (Blume, Dietrich, Lilienthal, Ternes, and Drotleff, 2015). The result of DSC for (Cordobés, Partal, and Guerrero, 2004) showed that the endothermic peak was in the range of 81,8 and 86,2°C when he use egg yolk gel with 51 wt% while the endothermic peak of our samples is in the range of 76,52 and 78,28°C. Although, the endothermic start at 60°C and in the case of our experiment start at 65°C.

Even the viscosity decreased on last day of storage. This can be explain by the fact that the composition of LEY changed. On the 14th day, we had to stop the measurement of the raw yolk because of the high contamination

Conclusion

As the results showed, the UHT treatment didn't accentuate the denaturation of the protein of LEY, and it increased the viscosity of LEY. Although, it can denatured the corposants responsible of coloration as carotenoid, polyphenol…

A detailed study of the effect of the UHT treatment on the functional proprieties of LEY as the emulsification ability is need.

References

Atılgan, M. R., & Unluturk, S. (2008). Rheological Properties of Liquid Egg Products (LEPS). *International Journal of Food Properties, 11*(2), 296-309.

Blume, K., Dietrich, K., Lilienthal, S., Ternes, W., & Drotleff, A. M. (2015). Exploring the relationship between protein secondary structures, temperature-dependent viscosities, and technological treatments in egg yolk and LDL by FTIR and rheology. *Food Chemistry, 173,* 584-593. https://doi.org/10.1016/j.foodchem.2014.10.084

Cordobés, F., Partal, P., & Guerrero, A. (2004). Rheology and microstructure of heat-induced egg yolk gels. *Rheologica Acta*, *43*(2), 184-195.

Mudannayaka AI, Wimangika Rajapaksha DS and Heshan Taraka Kodithuwakku KA (2016). Effect of Beeswax, Gelatin and Aloe vera Gel Coatings on Physical Properties and Shelf Life of Chicken Eggs Stored at Room Temperature. *J. World Poult.* Res. 6(1): 06-13.

Mendes de Souza P. Müller A. Beniaich A. Mayer-Miebach E. Oehlke K. Stahl M. Greiner R. Fernandez A., (2015).Functional properties and nutritional composition of liquid egg products treated in a coiled tube UV-C reactor. *Innovative Food Science and Emerging Technologies.* 32, 156-164.

Lechevalier, V., Guérin-Dubiard, C., Anton, M., Beaumal, V., David Briand, E., Gillard, A., … Nau, F. (2017). Pasteurisation of liquid whole egg: Optimal heat treatments in relation to its functional, nutritional and allergenic properties. *Journal of Food Engineering, 195,* 137-149.

Llave, Y., Fukuda, S., Fukuoka, M., Shibata-Ishiwatari, N., & Sakai, N. (2018). Analysis of color changes in chicken egg yolks and whites based on degree of thermal protein denaturation during ohmic heating and water bath treatment. *Journal of Food Engineering*, *222*, 151-161. https://doi.org/10.1016/j.jfoodeng.2017.11.024

Oladejo D., B.I.O. A-O, Olabisi P., (2015) Application of osmotic dehysration for shelf life extesion of fresh poultry eggs. *International Journal of Engineering and Applied Sciences* (IJEAS) ISSN: 2394-3661, Volume-2, Issue-6, June 2015

Zaheer, K. (2015) An Updated Review on Chicken Eggs: Production, Consumption, Management Aspects and Nutritional Benefits to Human Health. *Food and Nutrition Sciences*, 6, 1208-1220.