REHOLOGICAL PROPRIETES AND SENSORIAL ANALYSIS OF HEAT TREATED WHOLE EGG WITH ADDITIVES

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ABSTRACT

This study aimed to study the effect of adding additives before the heat treatment on whole liquid eggs (WLE). The different volume of citric and lactic acid was added to the WLE until we get the right pH. All the samples are packed and heat-treated at a water bath (70°C for approximately 3 minutes). For each pH, we measured the pH and the viscosity of the whole liquid egg before and after the heat treatment.

To determine the effect of the additive on the color, taste, smell, and texture of the whole liquid egg, a cupcake is made of it and taste it by the consumers.

The impact of the citric and lactic acid and the heat treatment is obvious in the samples comparing to the raw egg.

Keywords: whole egg, viscosity, citric acid, lactic acid…

Introduction

Eggs, in particular, chicken eggs, are recognized as a basic foodstuff for humans due to their high protein content and low cost (De Souza and Fernández 2013). They are prepared boiled, fried, or at times taken raw or as food supplement prepared in different forms depending on locality (Oladejo 2015). Currently, food manufactures using egg as a raw material such bakeries, confectioneries, large scale pastry manufactures prefer egg products (liquid whole egg, liquid egg white, liquid egg

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yolk as well as the powdered forms) (Nemeth et al., 2011). Besides, the food manufacturer has to ensure safe food products that are free from pathogenic microbial contamination (Campbell, Raikos, and Euston 2003). Even though the contents of fresh shell eggs are generally sterile, microorganisms, some of which are pathogens, can penetrate the shell and multiply under poor storage conditions (Uysal et al. 2017). For these reasons, in the egg product industry, the microbiological safety of liquid products is mainly guaranteed by pasteurization (Lechevalier et al. 2017). The most common pasteurization regimen used to obtain the reduction of Salmonella between 5 and 9 log cycles are 60°C for 3.5 min, 64°C for 2.5 min and 66°C for 4.5 min in the United States, United Kingdom and Europe, respectively (Marco-Molés et al. 2011; Patrignani et al. 2013). Heat treatment can provide microbial safety and increase the shelf life of egg products but can have harmful effects on the functional properties of egg proteins (Uysal et al. 2017). As a matter of fact, heat denatures (or unfolds) proteins, clumping together in a process called coagulation (Llave et al. 2018; Provost et al. 2016). Adding additives, including carbohydrates such as sucrose, glucose or fructose, or salt at 10% levels can protect susceptible egg proteins from damage and therefore allow higher temperatures, of approximately 3–6°C before heat damage occurs (Wu 2014). As a consequence, in this study the pH of the whole liquid egg is decreased by two different acids (Citric Acid and Lactic Acid), then water bath heat treated. The effect of additive on the rheological and functional proprieties was investigated by the modification of viscosity and the sensorial analysis before and after the heat treatment.

Materials and Method

All of the raw samples (whole liquid egg (WLE)) were supplied from the production line of Capriovus Ltd (Szigetcsép, Hungary). Directly after breaking, the raw whole liquid egg was homogenate in a piston-gap homogenizer at 100 bars. The samples were stored at a refrigeration temperature of 5°C during transportation to the laboratory.

The different volume of the solution of citric acid (20% w/w) and lactic acid (20% w/w) was added to raw WLE to have various pH of WLE (5.0, 5.5, 6.0, 6.5 and 7.0). Afterward, the samples were packed in polyethylene bags and heat-treated at a water bath (70°C for approximately 3 minutes). For each pH, we measured the pH by a pre-calibrated pH meter (Testo 206); and the viscosity of the whole liquid egg.

The viscosity measurements performed with Physical 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. The viscosity of sample solutions was tested with a 600 1/s deformation rate at 15°C. The Viscosity graphs were designed by Minitab v17.
To highlight the effect of additive on the functional proprieties of WLE and its customer perception, 10 different tasters taste omelet muffins. It was prepared from the treated whole liquid egg put on muffins mold and baked in the oven at 180°C for 15 minutes.

Results

pH

The liquid whole egg is made by homogenization and pasteurization of broken whole eggs (Miller et al. 2010). The pH of the liquid whole egg can vary from 7.0 to 7.6, usually 7.2 (Wu 2014). The pH values registered before the pH regulation and after the heat treatment are shown in Table 1. Both of the acids show some fluctuation in the pH values after the heat treatment.

Table 1. Initial and after heat treatment pH values

	Initial pH	pH 5	pH 5.5	pH 6	pH 6.5	pH 7
Citric Acid	**7,75±0,02**	**5,04±0,03**	**5,51±0,04**	**6,01±0,006**	**6,5±0,01**	**6,99±0,01**
Lactic Acid	**7,75±0,04**	**5,1±0,01**	**5,53±0,008**	**6,08±0,004**	**6,46±0,01**	**6,79±0,03**

Viscosity Measurements

Equally, the heat-treatment induced aggregation of egg protein, the precipitation of the egg protein affects the viscosity of liquid egg products. Figures 1 and 2 represent the effect of heat treatment combined by the ad of citric acid or lactic acid on the apparent viscosity of whole liquid egg comparing by the raw liquid egg.

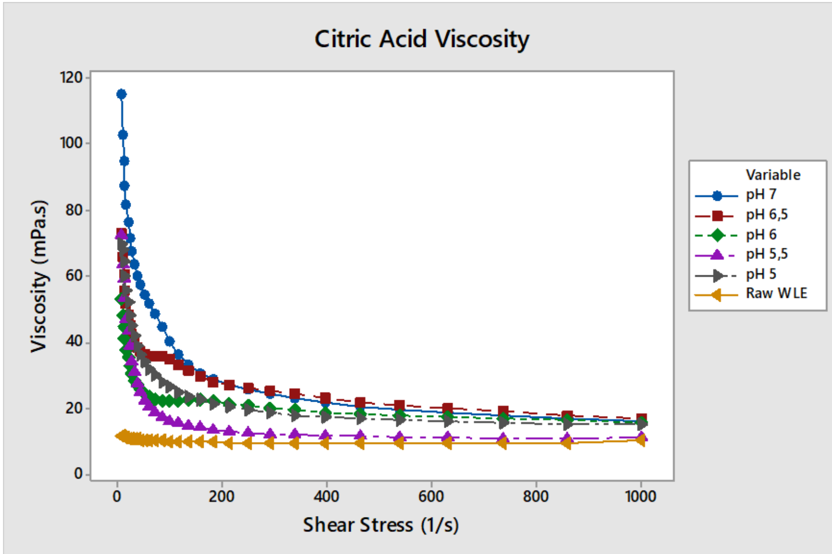

Figure 1. Rheological graph of WLE with Citric Acid

As it is shown in fig.1, the WLE with citric acid after heat treatment exhibit an apparent viscosity above the one of raw egg. Only WLE pH 5.5 showed similar viscosity as the raw egg starting from 400 1/s shear stress while the other viscosity curves still upper than the viscosity flow of raw WLE.

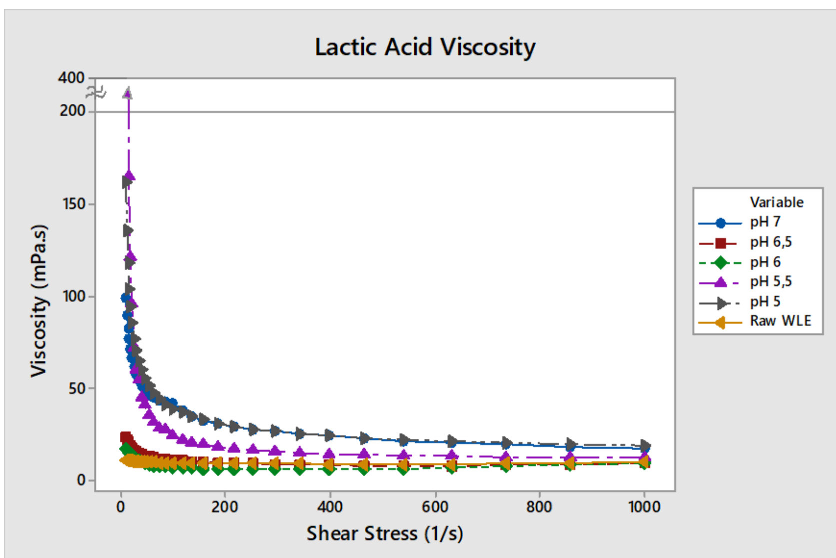

Figure 2. Rheological graph of WLE with Lactic Acid

In general, WLE with lactic acid pH 6 and 6.5 showed the same apparent viscosity as the raw WLE. While WLE pH 5, 5.5 and 7 at the beginning of the shear stress showed exceeding, viscosity compared to the raw one.

Sensorial analysis

For centuries, and throughout the world, the egg has an excellent reputation and has been used in many traditional dishes (Lechevalier et al. 2015). For these reasons, the sensory evaluation of WLE with additives is essential. The panel gives a score out of 10 for each sensory characteristics: color, smell, taste, and texture. The scores represented on spider web diagrams in Figures 3 and 4.

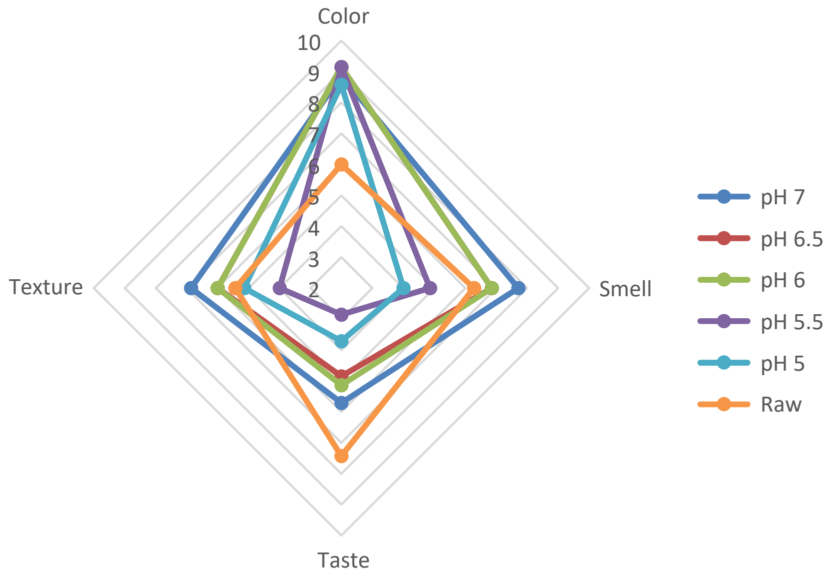

Figure 3. Sensory characteristics of WLE with Citric Acid and Raw Egg

Figure 4. Sensory characteristics of WLE with Lactic Acid and Raw Egg

Regardless of using lactic acid or the citric acid, in both cases, omelet muffins baked with WLE with additives were given better scores: 8.5-9.1 for omelet muffins with WLE with citric acid and 8-9.42 for the ones with WLE with lactic acid. Concerning the odor, omelet muffins pH 7 leading the score with 7.7 and 8.85 for citric and lactic acid respectively. While the omelet muffins pH 5 showed the inferior mark for the sensory proprieties smell and taste.

Differently, muffins pH 7 showed the same score for the taste as the raw egg 7.42 for the ones baked with WLE with lactic acid and a minor score than the raw egg for the ones baked with WLE with citric acid (5.71). Apropos the texture, as for the smell and taste, omelet muffins pH 7 shows the major score for citric and lactic acid with 6.85 and 7.42 respectively. Omelet muffins pH 6.5 shared the high score with muffins baked with lactic acid.

Discussion

The whole liquid egg is a blend of egg white and egg yolk (Wu 2014), so it can show the proprieties of both of them. Comparing to the starting pH, all the samples show a slight fluctuation after the heat treatment. The pH decreasing or the heat treatment who causes the unfolding of some proteins can be the reason of this negligible change.

Regarding the viscosity, the effect of the ad of citric acid is distinct on the apparent viscosity of all the samples (pH 5, 5.5, 6, 6.5 and 7) while this effect is showed only with samples of pH 5, 5.5 and 7 for lactic acid.

Despite that, the result of the ad of the additive is more obvious on the apparent viscosity of citric acid except that the effect of lactic acid is accentuated and the apparent viscosity starts from 356.5 mPa.s.

According to De Souza and Fernández 2013, the viscosity of egg white increase when the temperature takes place at 63°C indicating the initial of formation of egg albumen while this peak can be seen at 75°C for egg yolk; and the differential pattern observed by pasteurized whole egg can be generated by the effects observed in egg yolk and egg white components.

In the sensory evaluation, the panellists affirm that the color of omelet muffins baked with WLE with additives were the preferred ones. For the main sensory character taste, the score of omelet muffins pH 7 with lactic acid superimpose with the score of the raw whole egg. Although, it is the closet one to the score of the raw egg for the ones baked with citric acid. The omelet muffins pH 5 and pH 5.5 showed the lowest score for both of the acids because of the acid taste as mentioned by the panellists in their evaluation papers.

Conclusion

The ad of additive to the whole liquid egg had an impact on the rheological proprieties. The ad of lactic acid and decreasing the pH to 5 and 5.5 increase the apparent viscosity in a distinct way; while effect the citric acid was obvious in the graphs of the apparent viscosity for all the pH but it does not reach those of lactic acid. Since the first sight of the spider web diagrams, the panellists choice is indisputable, they accepted the omelet muffins pH 7 for both of the acids. However, the taster prefers the ones baked with WLE with lactic acid than the ones baked with WLE with citric acid.

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