THE EXAMINATION OF THE DIGESTIBILITY AND SENSORY PROPERTIES OF HIGH PROTEIN CREAM

[1]Blerina Mahmuti, [2]Zoltán Kovács, [3]Mohamed Outaira, [4]Judit Tormási, [5]Adrienn Varga- Tóth

Hungarian University of Agriculture and Life Sciences

Abstract:

The aim of this study is to investigate the digestibility and sensory parameters of protein- egg white enriched products. Parameters such as pH, colour, dry matter content, texture, rheological properties and protein digestibility were determined for four types of egg-white products: cream, extra cream, crumble and drink. Protein digestibility was analysed using the Kjeldahl method, whereas texture analyses used SMS Texture Analyzer. Significant changes in techno-functional parameters were observed. The cream sample showed the most significant colour changes; the crumble and drink sample remained within the same ranges; the extra cream showed colour uniformity. The pH showed that the cream sample showed slight shifts, while the extra cream and crumble sample remained relatively stable. Dry matter showed constant values for cream and extra cream, while the drink sample showed lower values. Rheological parameters were analysed using rheometer to determine viscosity, shear thinning, yield stress and viscoelastic properties. Initial results suggest that egg-white drink shows Newtonian behaviours. This study finds provides insights into the functional and sensory properties of high-protein cream products.

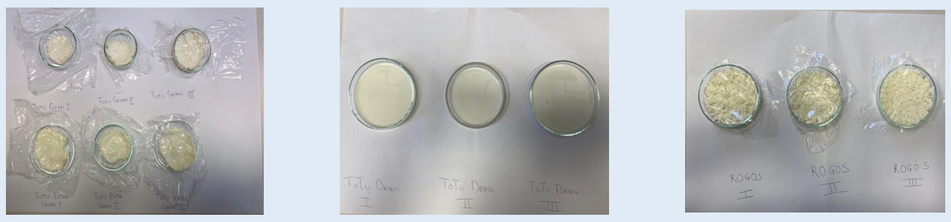
Keywords: protein digestibility; egg-white proteins; sensory paramenters; rheological parameters;

Introduction:

Eggs and products from chicken eggs have found a wide application in food industry, making them an essential part of the human diet worldwide. Eggs have three main components which are the shell, the egg yolk and the white. The white of egg makes up 58% of its volume, followed by the yolk (31%), and the shell (11%). The primary components of egg whites are water (88%), protein (10.5%), carbohydrates (0.5%), ash (0.8%), and fats (0.2%) (Campbell, Raikos, & Euston, 2003; Mine, 2010). Different types of proteins are present in EWPs, highlighting the most common amongst them globulin, avidin, lysozyme, ovalbumin, ovotransferrin, ovomucioid, and ovomucin (Mirarab Razi et al., 2022). In general, egg proteins are known as great proteins because of their good amino acidic structure and positive effect on muscle mass (Noh, Song, Yang, & Kim, 2023). Based on these attributes, EWPs are used significantly in the food industry for their functional qualities, which include binding adhesion, emulsification, heat-induced gelling, and foaming (Asaithambi, Singha & Singh, 2022).

Materials and methods

The used materials during the experiment were four different types of egg-white products cream, extra cream, crumble and drink milk replacement products. For each samples were performed pH measurements, colour measurements, dry matter content, texture analyses and viscozity measurements.



pH of samples was measured with a pen model pH meter- Testo 206, where after calibration 3 repetitions were made of each of the samples. The chromameter model used to measure the colour of the sample was Konica- Minolta CR-400 chromameter (Konica Minolta Sensing Inc., Osaka, Japan). This model operates on the principles of CIE Lab* colour space, a colorimetric system created to enhance human vision and selective colour using three coordinates: L* for lightness, a* for the green-red axis, and b* for the blue-yellow axis (Schanda, 2007).

$$\Delta E^* = \sqrt{\{(L_2 - L_1)^2 + (a_2 - a_1)^2 + (b_2 - b_1)^2\}}$$

Dry The percentage of dry matter was calculated using the formula: The dry matter content of the samples was calculated based on the original weight and the weight after placed in the drying oven at 105 °C for 24 hours following the formula:

Dry Matter (%) = (Dry Weight / Original Weight) × 100

Textural properties of the analysed samples were determined using Stable Micro Systems Texture Analyzer- TA. XT Plus model (fig. 2). The instrument can perform various mechanical tests, such as penetration tests, shear tests, texture profile analysis (TPA) and back extrusion tests, enabling precise, computer assisted measurements (Dash et al., 2022; Moore et al., 2020; Sidira et al., 2017; Özer & Kırmacı, 2010). The viscosity parameters were analysed using Anton Paar MCR 92 Rheometer (fig. 3). The samples used to determine the parameters such as viscosity, yield, shear thinning behaviour and viscoelastic properties were egg-white cream, egg-white drink and egg-white extra cream preparations in a rotating mode with a symmetric cylinder (Mourad et al., 2023).. Herschel- Bukley model was used to explain the flow cruve of the samples: (Abbasnezhat et al., 2015; Mourad et al., 2023)

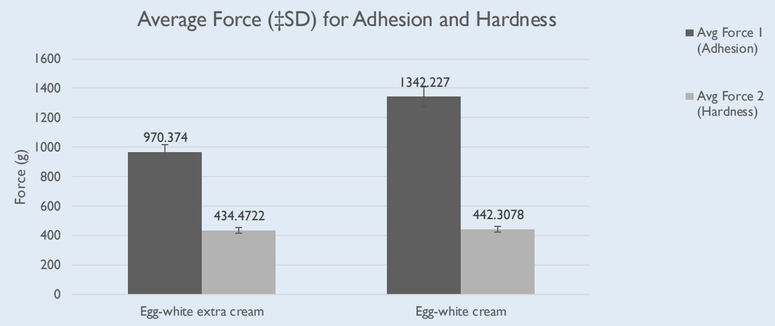
$$\tau = \tau 0 + K\dot{\gamma}^{n}$$

Results and discussions

Egg-white crumble showed the highest pH (7.46±0.02), indicating a stable and basic formulation, while egg-white drink had the lowest and most variable pH (6.52±0.54), indicating mild acidity and inconsistency. Egg-white drink also showed the highest standard deviation (0.54), indicating potential buffering challenges. Egg-white extra cream and cream had the highest L* values (>94), indicating a bright, white colour, while egg-white drink had the lowest (91.48). The most significant a* value was in egg-white crumble (-3.45), and the lowest was in egg-white drink (-2.26). b* values were positive for all samples, highest in egg-white crumble and lowest in egg-white drink (3.54). Egg-white extra cream and cream had similar dry matter content (17.96%, 17.27%), while egg-white drink had the lowest (7.46%). Egg-white crumble showed 35.94% dry matter with high standard deviation (±29.35).

Sample	pH	Colour			Dry matter
		L* (Lightness)	a* (Red- Green)	b* (Yellow- Blue)	
Egg-white extra cream	7.40 ±0.05	95.15 ± 2.24	–2.89 ± 0.03	8.13 ± 0.96	17,96 ± 0,77
Egg-white cream	7.06±0.12	93.26 ± 3.34	–2.91 ± 0.10	8.74 ± 0.24	17,96 ± 0,77
Egg-white crumble	7.46±0.02	94.54 ± 0.48	–3.45 ± 0.08	9.86 ± 0.26	17,96 ± 0,77
Egg-white drink	6.52±0.54	91.38 ± 1.13	–2.26 ± 0.39	3.54 ± 1.33	17,96 ± 0,77

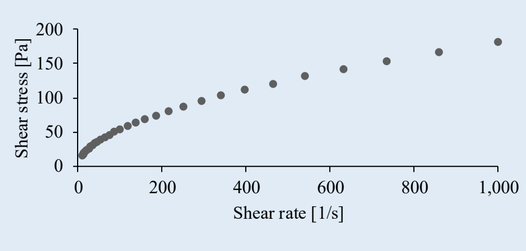
The analysed samples for texture were egg-white cream and egg-white extra cream. Egg-white cream showed a higher average adhesion force (1342 g) than egg-white extra cream (970 g), indicating it is stickier. However, egg-white cream had a significant standard deviation, while egg-white extra cream showed more consistent adhesion. Both samples had similar hardness (~435 g) with comparable variability, suggesting that differences in performance are mainly due to adhesion rather than hardness.

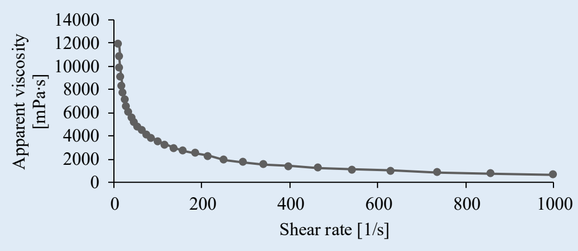


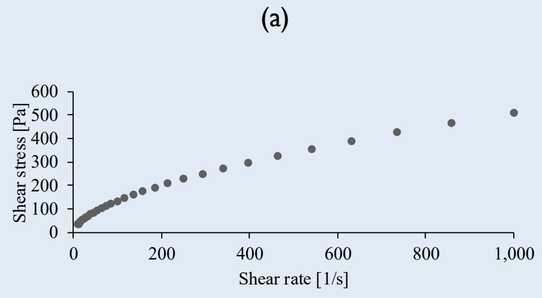
The flow curve of egg-white extra cream (a) shows a clear shear-thinning behaviour. This is confirmed by the viscosity curve (b), with a significant decrease in viscosity as shear rate increases. The Herschel–Bulkley model parameters support this: n = 0.5184, K = 21.76 Pa·s^n, and $\tau_0 = 0$.

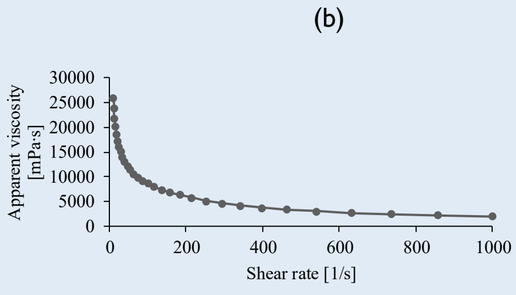
The flow curve of egg-white cream (c) shows a typical shear-thinning pattern. The viscosity curve (d) confirms this behaviour. The model parameters are n = 0.4863, K = 36.07 Pa·s^n, and $\tau_0 = 0$.

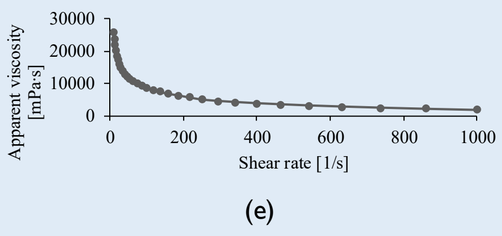
Egg-white drink showed a linear flow curve (e), indicating Newtonian behaviour. The viscosity remained constant (~10 mPa·s,) (f) Model parameters were n = 1.0121, K = 0.0101 Pa·s^n, and $\tau_0 = 0$.

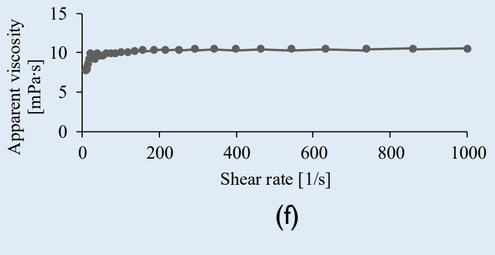












	τ0 (Pa)	K (Pa s^n)	n
	Egg-white extra cream		
Mean	0,0000	21,7617	0,5184
SD	0,0000	2,0855	0,0256
	Egg-white cream		
Mean	0,0000	36,0713	0,4863
SD	0,0000	11,9320	0,0466
	Egg-white drink		
Mean	0,0000	0,0101	1,0121
SD	0,0000	0,0028	0,0269

Conclusions

This study findings show that egg-white based products have diverse physicochemical and rheological properties based on their formulation and processing. Egg-white crumble showed highest ranges of pH and dry matter content, whilst the lowest pH and dry matter was showed by egg-white drink due to its liquid nature. Egg-white drink sample showed significantly different ranges of colour. Based on the results of viscosity measurements, egg-white cream and extra cream showed pseudoplastic behaviours, accompanied with strong intermolecular interactions. On the other hand, egg-white drink showed behaviours of a Newtonian fluid with low viscosity. These characteristic highlights how products with different processing and form impact functional characteristics of egg-white products, gaining valuable insights for future research in product development.