

Use of olive oil-in-water gelled emulsions in model turkey breast emulsions

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Abstract. Today, gelled emulsion systems offer a novel possibility in lipid modification of meat products. In this study, we aimed to investigate the quality characteristics of model turkey emulsions that were prepared with olive oil-in-water gelled emulsion (GE) as partial or total beef fat replacer. The results indicated that while most of the GE treatments showed equivalent emulsion characteristics in terms of emulsion stability, water-holding capacity and cook yield, utilization of 100% GE as the lipid source could increase total expressible fluid of the model turkey emulsion and thus negatively affect the quality. Utilization of GE was effective in total fat reduction, as the model turkey emulsions formulated with more than 50% GE had significantly lower fat content compared to full-beef fat control model emulsion. However, beef fat replacement with GE produced considerable changes in colour parameters. Finally, it was concluded that utilization of GE as a partial beef fat replacer has good potential to enhance stability and reduce total fat in turkey meat emulsion products.

1. Introduction

Although the consumption of poultry meat products has been continuously increasing in the last decades, consumers currently associate further processed meat products as a high animal fat-containing, unhealthy food source. Therefore, an important goal for the meat industry is to suggest novel lipid modification strategies. Incorporation of gelled emulsion (GE) in poultry product formulations is one of the new approaches in lipid modification that ensures both the product yield and healthier composition. An emulsion gel is defined as “an emulsion with a gel-like network structure and solid-like mechanical properties” [1]. GEs mimic the functional and sensory characteristics of animal fat used in most of the widely-consumed meat products [2]. Olive oil has long been known as a functional vegetable oil that is a rich source of mono- and polyunsaturated fatty acids, providing beneficial health impacts [3]. In this study, we aimed to research the effects of olive oil-in-water GE as beef fat replacers in model turkey emulsions, with particular regard to emulsion stability parameters and final quality.

2. Materials and Methods

Fresh boneless, post-rigor turkey breast muscles (*Pectoralis major*), beef fat (BF), olive oil and other ingredients were purchased from the local market. For preparation of GEs, the oil phase (50 g/100 g emulsion) containing polyglycerol polyricinoleate (PGPR) as surfactant (6.4 g/100 g oil), was added to the aqueous phase containing 3 g gelatine/100 g emulsion and 9 g inulin/100 g emulsion, and homogenized. Both phases were previously heated separately to 55°C on a hot plate stirrer. After the



homogenization process (6000 rpm, Ultra-Turrax® T25, UK), the emulsion was cooled to room temperature.

The GE was kept for 12 h at 4°C until being used in meat emulsions [4]. Model system turkey emulsions were produced according to Öztürk *et al.* [5]. Each treatment was prepared to initially contain 20% total lipid. Control (C) group consisted of 100% BF, whereas GE treatments were formulated by replacing 30% (G1), 50% (G2), 70% (G3) or 100% (G4) of BF. Turkey breast muscles and beef fat were separately minced through a 3 mm plate grinder (Arnica, Turkey). Minced meat was homogenised for 1 min using a kitchen-type mixer (Tchibo, Germany) that was placed in ice bath. After that, BF (control) and/or GE, half of the ice, sodium chloride (1%), sodium tripolyphosphate (0.5%) and sodium nitrite (0.015%) were added and mixed for 1 min. The other half of the ice was then added and mixing was continued again for 2 min.

Emulsions were placed in hermetically sealed centrifuge tubes and centrifuged at $3100 \times g$ at 4°C for 1 min to eliminate any air bubbles. These were then heat-treated in a 70°C water bath for 30 min and cooled to room temperature. Turkey model emulsions were stored in sealed tubes at 4°C prior to analysis. Emulsion stability (ES) as total expressible fluid (TEF) and expressible fat (EFAT) [6], water-holding capacity (WHC) [6], and cook yield (CY) [7] were analysed to evaluate turkey model emulsion characteristics. pH was measured by using a pH-meter equipped with a penetration probe. Total moisture, protein and ash analyses were carried out according to AOAC [8]. Total lipid content was evaluated according to Flynn and Bramblett [9]. Colour (L^* , a^* , b^*) of the emulsions was measured with a portable colorimeter (Konica Minolta, Japan). Data was analysed by ANOVA and Duncan's Post-Hoc tests using the SPSS software.

3. Results and Discussion

TEF and EFAT, WHC and CY results are presented in figure 1a, 1b and 1c, respectively. TEF was recorded as being between 6.23-10.65% in the various model turkey emulsions. G4 emulsions had the highest TEF value among the formulations ($P < 0.05$), whereas G1 and G2 emulsions had similar TEF compared to C emulsions.

This result showed that increased concentrations of GE might have an undesired impact on emulsion stability but concentrations of 30% and 50% should favour stability. EFAT values were between 6.73-9.08%, where the lowest value was measured in G1 group, indicating that this emulsion had good stability in terms of both expressible fluid and fat.

The other groups had similar EFAT compared to the control. WHC of the model turkey emulsions were in the range of 54.29-63.67% and all the GE model turkey emulsions showed similar WHC to C emulsions. In GE treatments, G2 group had higher WHC than G4 ($P < 0.05$). Thus, the total fat replacement seemed to decrease WHC. The CY measured was between 94.93-96.83%, where GE model turkey emulsions had similar values to C emulsion, in accordance with WHC results. Similar to our results, Serdaroğlu *et al.* [4] reported that total beef fat replacement with olive oil GEs in model beef emulsions could negatively affect emulsion characteristics, but could show equivalent stability when replacement level was up to 50%.

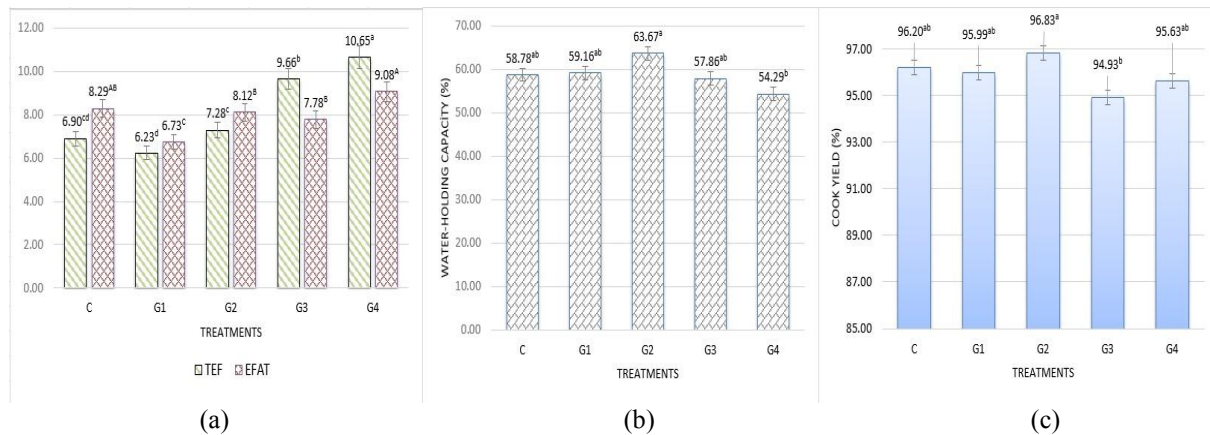


Figure 1. (a) Emulsion stability (TEF & EFAT), (b) WHC and (c) CY of the treatments. Different letters indicate significant difference ($P < 0.05$). Standard deviation of the means was recorded between 0.21-1.81, 0.06-0.89, 1.13-2.74 and 0.03-0.84 for TEF, EFAT, WHC and CY, respectively.

Chemical composition and pH values of the model turkey emulsions are presented in table 1. Total moisture, protein, lipid and ash content were between 62.62-66.01, 16.45-17.82, 10.45-16.64 and 1.98-2.21, respectively. No significant differences were obtained in moisture and protein content of the model turkey emulsions. Similar moisture contents could be attributed to the similar WHCs of the model turkey emulsions.

In addition, since added GE was not a source of protein, the total protein content of the model turkey emulsions did not differ. A significant lipid reduction was achieved in the model turkey emulsions formulated with more than 50% GE ($P < 0.05$). This result showed that incorporating GEs in turkey product formulations could offer a favourable advantage, promoting healthier composition of the meat products.

The lowest lipid content was recorded in G4 emulsions ($P < 0.05$), whilst G2 and G3 emulsions had similar lipid content. Ash content of G4 emulsions was also significantly lower than other treatments ($P < 0.05$). pH values of the treatments range between 5.99-6.06. G2 and G3 emulsions had similar pH value compared to C, but pH value was higher in G4 and lower in G1 than in C emulsions ($P < 0.05$). Therefore, an average level of GE should be useful to maintain the pH value.

Table 1. Chemical composition and pH values of model turkey emulsions.

Treatments	Moisture (%)	Protein (%)	Lipid (%)	Ash (%)	pH
C	63.26 $\pm$ 1.02	17.55 $\pm$ 1.41	16.64 ^a $\pm$ 0.38	2.21 ^a $\pm$ 0.07	6.02 ^b $\pm$ 0.01
G1	62.62 $\pm$ 0.65	17.40 $\pm$ 0.31	16.41 ^a $\pm$ 0.45	2.18 ^a $\pm$ 0.03	5.99 ^c $\pm$ 0.01
G2	65.55 $\pm$ 1.26	16.45 $\pm$ 1.06	13.74 ^b $\pm$ 0.14	2.16 ^a $\pm$ 0.03	6.01 ^b $\pm$ 0.01
G3	66.01 $\pm$ 1.27	17.12 $\pm$ 1.00	12.72 ^b $\pm$ 0.50	2.13 ^a $\pm$ 0.09	6.01 ^b $\pm$ 0.01
G4	65.73 $\pm$ 1.12	17.82 $\pm$ 0.70	10.45 ^c $\pm$ 0.36	1.98 ^b $\pm$ 0.03	6.06 ^a $\pm$ 0.02

a, b, c: Different letters indicate significant difference ($P < 0.05$).

Data is presented as mean values $\pm$ standard deviation.

Colour parameters of model turkey emulsions are shown in figure 2. L^* , a^* and b^* values were between 74.43-77.79, 2.92-5.30 and 8.18-11.43, and replacement of beef fat with GEs led to significant differences in all of the colour parameters ($P < 0.05$). The lowest L^* and b^* and the highest a^* values were recorded in C emulsions ($P < 0.05$). Thus, utilization of GE resulted in increased L^* and b^* and decreased a^* values ($P < 0.05$). G4 emulsions had the highest L^* value ($P < 0.05$) while L^* values were similar in G1, G2 and G3 emulsions, meaning that GE concentrations more than 70%

could produce a larger change in L^* values. In GE treatments, a^* values were decreased with increased GE concentrations ($P<0.05$), except in G2 and G3 emulsions that had similar a^* values. In b^* values, an increasing trend was recorded with increased concentrations of GE ($P<0.05$), probably due to the natural yellow-greenish colour of olive oil used in GE formulations. Similar to our study, Serdaroğlu *et al.* [4] reported that addition of GE in model beef systems increased lightness and yellowness but reduced redness compared to control samples. It should be noted that since instrumental colour parameters are not certainly in a linear relationship with colour acceptability, the visual satisfaction of the consumers should be evaluated in products formulated with GEs.

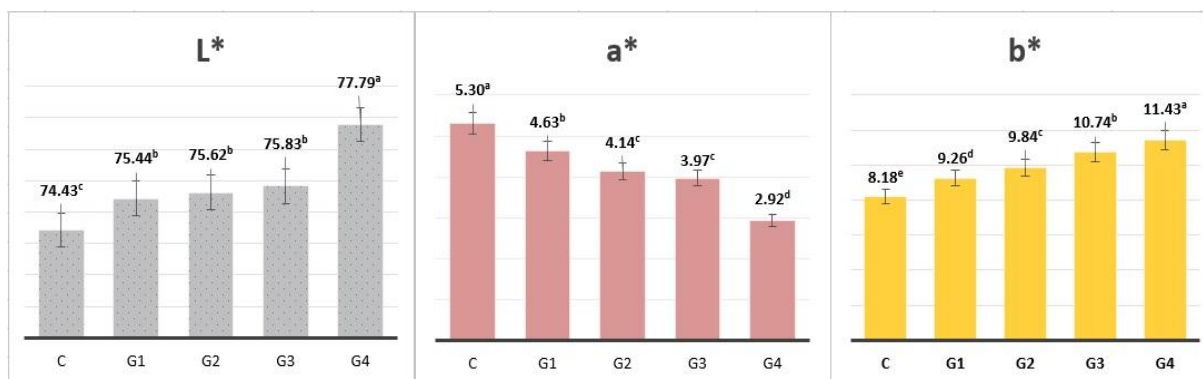


Figure 2. L^* , a^* and b^* values of the model turkey emulsions. Different letters indicate significant difference ($P<0.05$). Standard deviation of the means was recorded between 0.19-1.15, 0.30-0.83 and 0.05-1.16 for L^* , a^* and b^* , respectively.

4. Conclusion

The results of our study indicated that incorporating GE into model turkey meat emulsions presented favourable effects in terms of emulsion stability and fat reduction. Utilization of GE resulted in turkey meat emulsions with equivalent emulsion stability parameters to full-beef fat turkey meat emulsions, and thus, the use of GE offers technological advantages. However, increased concentrations of GE could have a negative impact on emulsion stability parameters in terms of expressible fluid, although no significant changes were observed in water-holding capacity or cooking yields. Reductions in total fat were obtained in model turkey emulsions that were produced with more than 50% GE as beef fat replacer, which is key to development of healthier product formulations. However, the colour parameters were highly affected by GE incorporation. Further study should be performed regarding the adoption of GE in various meat products.

References

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