EFFECT OF ADDITION OF β-GLUCAN AND REDUCED FAT CONTENT IN CHICKEN EMULSION

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Abstract – β-glucan has been used for fat substitutes, decreased cooking loss, and increased emulsion stability. The effect of addition of β-glucan on the yield, emulsion stability, and emulsion staining procedure of low fat chicken emulsion were evaluated. The chicken emulsion were prepared with ground chicken breast added with 1.0% (HG) 0.5% (MG) and 0% β-glucan (LG) respectively, then mixed with 25% (HF), 20% (MF), 15% (LF) chicken skin respectively. All the samples were stored at 4°C until analyze. The yield, emulsion stability and emulsion staining procedure of the samples were analyzed. The results observed that, the addition of β-glucan resulted in the percentage of yield increased, whereas the percentage of the total expressible fluid (TEF) and fat decreased. For the emulsion staining procedure image, adding high level of β-glucan resulted in fats with more uniform globules.

Key Words – β-glucan, chicken emulsion, emulsion stability, emulsion staining procedure

I. INTRODUCTION

In recent years, the growing consumer demand for healthier meat products, because the meat based products are often have high fat content which can be associated several health problems, for example obesity and cardiovascular diseases [1]. Consumers prefer poultry meat probably because of its low-fat content. However, fat plays an important role in the stabilizing formation of meat batter, as it exerts considerable influences on the binding anilities of protein molecules [2].

The β-glucan has been used for fat substitutes [2], decreased cooking loss, and increased emulsion stability [3]. Accordingly, the objective of the current study was to investigate the effects of addition β-glucan and reducing fat content on chicken emulsion by evaluating the yield, emulsion stability and emulsion staining procedure.

II. MATERIALS AND METHODS

Fresh chicken breast and chicken skin were obtained from Charoen Pokphand Enterprise (Taichung, Taiwan). The OatWell® (22% β-glucan) was obtained from Gemfont (Taipei, Taiwan). Chicken emulsion was prepared with ground chicken breast added with 1.0% (HG) 0.5% (MG) and 0% β-glucan (LG) respectively, then mixed with 25% (HF), 20% (MF), 15% (LF) chicken skin respectively. The percentage of yield was measured by the method described by Álvarez and Barbut [3]. Thirty-five gram of chicken emulsion were centrifuged (Micro220r, Hettich, Germany) at 3,600 rpm for 1 min to remove air bubbles. The samples were cooked in a water-bath (G-20, DENG YNG, Taiwan) at 72°C for 1.5 h and cooled in a cold-water bath for 5 min. Then, the chicken emulsion was removed from the tubes, blotted dry with paper towel, and weighed for percentage of yield.

Yield (%) = $100 - [(m_{raw} - m_{cooked})/m_{raw} \times 100]$ (n=5).

Emulsion stability was examined according the method of O'Flynn *et al*. [4]. Thirty-five gram of chicken emulsion centrifuged at 3,600 rpm for 1 min. The samples were cooked in a water-bath at 70°C for 30 min, and then centrifuged at 4,000 rpm for 3 min. The samples were removed and weighed. The fluid poured into crucibles and dried overnight at 100°C. The total expressible fluid (TEF) and the percentage fat were determined using the following formula:

TEF = (Weight of centrifuge tube and sample) − (Weight of centrifuge tube and pellet).

%TEF = TEF/Sample weight × 100.

% Fat = [(Weight of crucible + dried supernatant) – (Weight of empty crucible)]/TEF × 100.

Emulsion staining procedure was conducted according to the method of Hepler [5]. The emulsion was smeared on the slide and refrigerated at 4^{o}C for 24 h. The color stains (i.e., fat stain and protein stain) were prepared for 2 days before using. The slide was rinsed in 70% alcohol and then flooded with the fat stain for 45 s, then, the stain was washed off with 50% alcohol and distilled water. The slides were stained with the protein stain for 3 min and rinsed off with water, which added few drops of ammonium hydroxide.

RESULTS AND DISCUSSION

It was found that the percentage of yield was significantly higher (P < 0.05) in the chicken emulsion with addition of 1% β-glucan (Fig. 1). This result agreed with Álvarez and Barbut [3], who reported that adding β-glucan to decrease cooking loss of the meat products. Warner and Inglett [6] explained that β-Glucan produced a tridimensional network (as a result of its soluble fiber), leading to holding ability of water and fat increased, eventually resulted in the decrease of cooking loss.

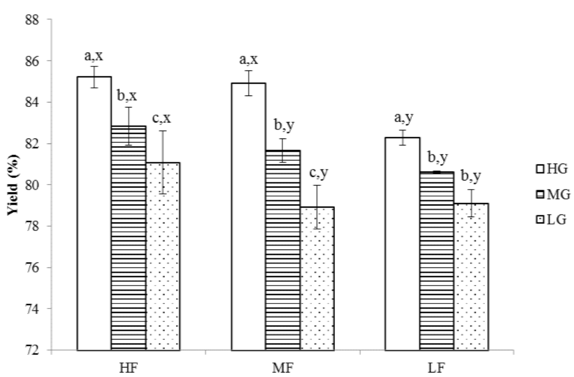

Figure 1. Yield (%) in chicken emulsion added 1% β-glucan (HG), 0.5% (MG), 0% (LG), and 25% fat (HF) 20% (MF) 15% (LF). Letters ($^{a, b, c}$) denote significant difference (P < 0.05) between different β-glucan addition. Letters ($^{x, y, z}$) denote significant different (P < 0.05) between different fat addition.

Between the samples with the same adding levels of β-glucan, the yield increased with the increasing fat content. The study done by Morin *et al.* [2] showed that, the breakfast sausage with 22% fat had lower cooking losses than the one with 12% fat with 0.3% water. The high-fat meat products had lower cooking loss was probably because of the positive action of fat in the meat batters which acting as spacers in the protein network [7].

The total expressible fluid (% TEF) is shown on Fig. 2. The TEF was higher as the fat content was raised from 15% to 25% and as the β-glucan level was raised from 0% to 1%. This result was because of the greater amounts of water were added as well as the combination of the high water binding of β-glucan [1]. A stable gel matrix leaded to lower water and fat losses, as a resulted of improving the binding properties of meat emulsions [8]. Decrease in TEF with increasing fat content was observed. Brummel and Lee [9] reported that hydrocolloids could bind a relative large amount of water while maintaining a fat-like texture in systems. Fat reduction in cooked meat products resulted in decreasing emulsion stability which corresponding to the lower binding properties [1].

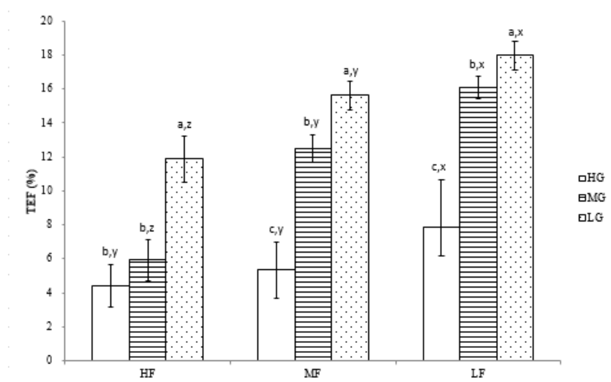

Figure 2. The total expressible fluid (%) (TEF) in chicken emulsion added 1% β-glucan (HG), 0.5% (MG), 0% (LG), and 25% fat (HF) 20% (MF) 15% (LF). Letters ($^{a, b, c}$) denote significant difference (P < 0.05) between different β-glucan addition. Letters ($^{x, y, z}$) denote significant different (P < 0.05) between different fat addition.

Fig 3. showed that, the fat (%) of the TEF ranged from 91.54 to 93.83; fat content was significantly affected the fat (%) in TEF. At the same level of β-glucan added, the low fat content resulted in a high fat loss; it was probably because of the reduction of fat content in meat emulsion could change in the emulsion stability parameters, such as fat and water losses during cooking, and affected the final quality [10].

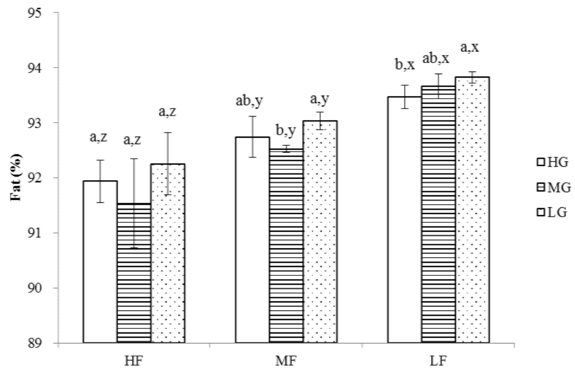

Figure 3. The fat (%) in total expressible fluid (TEF) in chicken emulsion added 1% β-glucan (HG), 0.5% (MG), 0% (LG), and 25% fat (HF) 20% (MF) 15% (LF). Letters ($^{a,\ b,\ c}$) denote significant difference (P < 0.05) between different β-glucan addition. Letters ($^{x,\ y,\ z}$) denote significant different (P < 0.05) between different fat addition.

At the same level of fat content, the one with higher level of β-glucan had less fat loss. Dietary fibers, such as β-glucan, can be used to reduce fat content in meat products; dietary fiber can form a compact gel formation probably because fibers can retain fat and water [11]. β-glucan could be a fat-replacement probably because its ability to help forming dense matrices, which can hold large amount of water [10].

In emulsion staining procedure images of chicken emulsion, the red color and blue parts represent fat globule and protein, respectively. The number of fat globules in the high fat content samples was obviously higher than that in the low fat content samples. In the low β-glucan (0.5, 0%) added samples, parts of fat globules started to coalesce and formed larger globules. The high β-glucan added samples exhibited more regular forms.

III. CONCLUSION

In conclusion, addition of β-glucan in emulsion resulted in an improvement of chicken emulsion stability. The chicken emulsion with addition of 1% β-glucan and 20% fat content had the highest yield; it had similar result of TEF (%) and fat (%) with the samples with 25% fat content. Therefore, the reduction of fat content from 25% to 20% did not affect the stability of chicken emulsion.

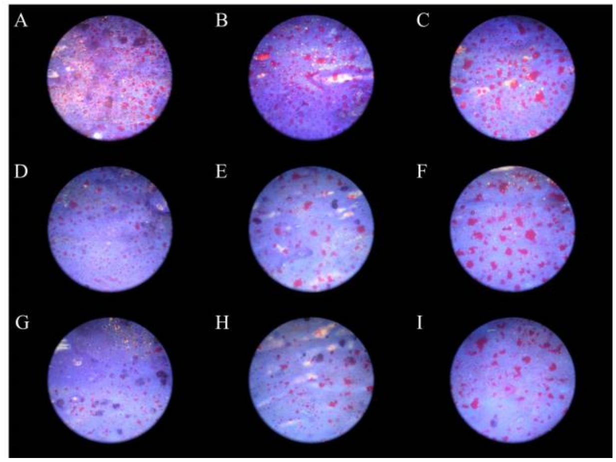

Figure 4. The emulsion staining procedure images of chicken emulsion: (A) 25% fat, 1% β-glucan (HFHG), (B) 25% fat, 0.5% β-glucan (HFMG), (C) 25% fat, 0% β-glucan (HFLG), (D) 20% fat, 1% β-glucan (MFHG), (E) 20% fat, 0.5% β-glucan (MFMG), (F) 20% fat, 0% β-glucan (MFLG), (G) 15% fat, 1% β-glucan (LFHG) , (H) 15% fat, 1% β-glucan (LFMG), (I) 15% fat, 0% β-glucan (LFLG).

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