Effect of dipping and dusting on quality of fried chicken during storage

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Abstract

Fried foods are very common and generally consumed worldwide. In the fried chicken, batter coating plays an important role on product quality. This study aimed to determine effect of dipping and dusting on quality of the fried chicken during storage at 50°C for 3 h. Prior to frying at 170°C, the reformed chicken meat was subjected to 4 conditions including 1) dipping in batter with 0% Hydroxypropyl methylcellulose (HPMC), 2) dipping in batter with 2% HPMC, 3) dipping in batter with 0% HPMC and dusting with wheat flour and 4) dipping in batter with 2% HPMC and dusting with wheat flour. By further dusting after dipping in batter with HPMC could maintain crispness of the fried chicken storage at 50°C for 3 h. From the triangle test, dusting could maintain crispness of the fried chicken for 3 h without significant difference between freshly fried chicken and 3 h-storage fried chicken. Moreover, the moisture content of the fried chicken crust from dipping in the batter with 2% HPMC and dusting was remained at the lowest during storage. Therefore, the optimum condition was that chicken should be dipped in the batter containing 2% HPMC and dusting in the wheat flour before frying at 170°C.

1. Introduction

Food batter is a complex system comprised of water, flour (or starch) and seasoning. Prior to frying, food is dipped in the batter or dipped in the batter and dusted. Batter coating can enhance food flavor, texture and appearance. Furthermore, it acts as a barrier against loss of moisture (Albert *et al*., 2009). Therefore, the final product with batter coating is tender and juicy inside and crispy outside. Crispy coating is the critical part of the fried food. Surface appearance and texture are also important factors for consumer acceptability.

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In the batter system, wheat flour provides the required viscosity and structure. Polysaccharides in the flour interacted with protein to provide stability. The stability depends on wheat gluten and the level of available of water to firm flowing batter. When food is dipped in the batter, wheat gluten in a batter forms the film that can reduce moisture loss and produce crisp and appetizing surface. This is because wheat flour contains some reducing sugar that can develop caramelization during frying, contributing to the color and flavor of the batter coating. Hydroxypropyl methylcellulose (HPMC) with film forming properties could increase moisture retention and reduce oil pick up. When the product was coated with the film, the surface gas concentration may change during storage (Albert *et al*., 2009). In frying, the food is in a direct contact with very hot oil at (160–180°C); as result, heat transfer is fast. A large temperature gradient is created at the food/oil interface. Frying can enhance product color, flavor, texture and appearance (Ballard, 2003).

Dusting is applied to a food in a dry form preliminary to create a desired coating texture. It is a dry food made from flour, starch, seasoning and is coarse in nature. The coating can be fine to coarse in particle size. The coating reduces dehydration, browning and gives a crisp texture to the fried parts (Chen *et al*., 2008). Additionally, battered and breaded foods are very common in developing countries and food usually contains a considerable amount of oil. Coating the meat with dipping and dusting provided a sustainable protective effect to the meat inside and it shown significant improve in yield and maintain in tender during frying operation (Mallikarjunan *et al*., 2010).

Therefore, final product quality depends on not only frying condition but also on the types of the food. This project aimed to determine effect of dipping and dusting prior to frying on the quality of the fried chicken during storage.

2. Materials and Methods

ALL purposed wheat flour (Diamond star, Yangon, Myanmar) was used for batter development of fried chicken. Minced chicken breast meat was purchased from a local supermarket. Hydroxypropylmethylcellulose (HPMC, (E464: HPMC) was from Kenwood Ltd, UK. Premix was composed of 0.70% refine salt, 0.28% refine sugar, 0.50% chicken powder, 0.10% white pepper powder, 0.06% rosemary seasoning, 0.02% paprika powder, 2.00% wheat flour, 4.00% tapioca starch, 0.80% isolated soy protein and 11.54% cool water and mixed with 80 % of minced chicken breast meat. Batter consisted of 40.96% wheat flour, 4.14% corn flour, 0.98% baking powder, 0.44% pepper powder, 0.44% salt, and 0.33% chicken powder, 0.22% paprika powder, 0.22% sugar and 52.29% water.

2.1 Preparation of chicken and batter

Minced chicken was mixed with the premix using a food processor (Combimax 600, Braun, Kronbery, Germany) at speed 10 for 300 s. The mixed chicken was weighted (15±1g per piece) and reformed in a rectangular block. HPMC (0% and 2%, based on dry mix) was mixed with water using a 1:63 (HPMC powder: water) ratio at 95–100°C until the solution became transparency and the gel was set. Then all ingredients were mixed with cold water (52%) using a food mixer (Model 5K5SS, Kitchen aid, USA) at speed 4 for 330 s to make the batter. Then, the reformed chicken (15 g) was dipped in the batter and some of them were further dusted with wheat flour. From preliminary study, addition of 2% HPMC yielded the best quality of the fried chicken. Therefore, experiment was designed by the completely random design (CRD). There were totally 4 treatments including 1) dipping in batter with 0% HPMC (control), 2) dipping in batter with 2% HPMC, 3) dipping in batter with 0% HPMC and dusting with wheat flour and 4) dipping in batter with 2% HPMC and dusting with wheat flour.

2.2 Frying

Ten pieces of chicken were deep fried in palm oil (Waew brand, Thailand) at 170°C for 300–360 using an electrical fryer (Fritel, compact 15, series 98/10, Belgium). After frying, the fried chicken was kept at 50°C in an electrical oven (Model MP 9489 SRC, LG, Thailand) for 3 h.

2.3 Quality determination

2.3.1 Coating pick up

Coating pick up was determined as the amount of coating adhering to chicken meat. It was calculated using equation 1 (Albert *et al*., 2009).

$$\text{Coating pick up (\%)} = [B / B+S] \times 100 \quad (1)$$

where B is the mass of batter coating (g) and S is the mass of chicken excluding coating (g).

2.3.2 Cooking loss

Cooking loss was determined as the weight loss during frying. It was calculated using equation 2 (Mallikarjunan *et al*., 2010).

$$\text{Cooking loss (\%)} = \left[\frac{X1-X2}{X1}\right] \times 100 \quad (2)$$

where X1 is mass of material before frying (g) and X2 is mass of product after frying (g).

2.3.3 Color measurement

Color of the fried chicken crust was determined using a spectrophotometer (Minolta CM-3500d; Konica Minolta Holding Inc, Tokyo, Japan) by reflectance. CIELAB parameters (L*, a* and b*) were obtained using a D65 illuminant at 10°C observation.

2.3.4 Moisture content

Moisture content of crust and crumb was determined using an oven method (AOAC, 2000).

2.3.5 Texture analysis

A TA-XT plus texture analyzer (Stable micro system, serial no.10580, UK) was used to evaluate hardness of the fried chicken during storage for 0–3 h. The fried chicken of each treatment (10 pieces) was evaluated by the compression test mode. The test settings were 2 mm/s test speed, 5 g trigger force, 20 mm blade displacement. The sample was placed on base and jogged the machine down to cut the product with a knife blade (HDP/BSW: Blade set with Warner Bratzler).

2.3.6 Sensory evaluation

After 2 and 3 h storage, the fried chicken was sampling to evaluate the sensorial quality using the triangle test by 30 untrained panelists. The serving samples included freshly fried chicken and storage fried chicken. This was to test the difference between the freshly fried product and the storage fried product.

2.4 Statistical Analysis

Experimental data were analyzed using ANOVA in the statistical package SPSS® version 12.0 [SPSS (Thailand) Co., Ltd., Bangkok, Thailand]. Duncan's multiple comparisons of mean values were carried out at the level of significance $p \leq 0.05$.

3. Results and Discussion

3.1 Effect of dipping and dusting before frying on coating pick up and cooking loss of fried chicken

After frying, samples from the dipping in the batter with 2% HPMC and dusting treatment had a higher coating pick up than samples without dusting ($p \leq 0.05$) (Table 1). When there was no HPMC, the coating pick up of samples from dipping and dusting treatment was less than that from only dipping treatment. It was because the dusting material did not adhere properly. Addition of HPMC provided the better adhesion ability of batter. It increased viscous and adhesive properties. As a result, pasting viscosity and cooking stability were improved. Batter setting time on food surface was also faster (Mallikarjunan *et al.*, 2010). Thus, dipping with HPMC and dusting would be likely to facilitate faster batter setting and improve batter adherence on chicken surface. As a result, overall quality of the fried product should be improved. However, only dipping without dusting could not prevent cooking loss and moisture migration in final products. Therefore, the cooking loss of the control treatment was significantly higher than others.

Table 1 Cooking loss and coating pick up of the fried chicken

Treatment	Before dipping (g)	After dipping (g)	After frying (g)	Cooking loss (%)	Coating pick up (%)
Dipping (Control)	15.48 ± 0.88 [b]	21.71 ± 0.44 [a]	15.39 ± 0.34 [b]	29.05 ± 0.21 [a]	28.87 ± 1.35 [c]
Dipping 2 % HPMC	15.56 ± 0.18 [a]	22.60 ± 0.43 [a]	16.28 ± 0.21[b]	27.99 ± 0.47 [a]	31.15 ± 0.52 [b]
Dipping & Dusting	15.78± 0.13 [a]	21.61± 0.90 [a]	16.65 ± 0.85[b]	21.44 ± 4.13 [b]	26.19 ± 0.21 [d]
Dipping 2% HPMC & Dusting	15.90 ± 0.60 [a]	22.84 ± 0.11 [a]	17.97 ± 0.61 [a]	25.05 ± 2.21 [a]	33.24 ±0.09 [a]

Note: [a–b] mean within the same row with different letters are significantly different ($p \leq 0.05$)

3.2 Effect of dipping and dusting before frying on color of fried chicken

For fried chicken with batter, wheat flour in the batter contained some reducing sugars that could have caramelization during frying and contribute to color of the fried chicken crust (Kuntz, 1995). Color could be defined as the energy distribution of light reflected by a fried food. L* value represented the color lightness. In this study, generally, there was no significant difference (p>0.05) in L* value of the fried chicken during 3 h storage (Table 2). However, an increase in a* value (redness) of the control samples was observed during storage. This could be from non-enzymatic browning reaction affected primarily by the presence of reducing sugars in the batter (Suderman, 1990). Compared with the control sample, the a* value of the dipping with 2 % HPMC sample was slightly decreased (Table 3). It is possible due to dilution of protein content when HPMC was applied. The increased a* value was typically associated with the decreased L* value. Regarding b* value, all fried chicken crust had the b* values in a range of 30.95–37.58. Variation in b* values during storage was little. In addition, the dipping and dusting prior to frying tended to increase the yellowness of the crust (Table 4).

Table 2 The L* value of fried chicken during 3 h storage

Treatment	0 h	2 h	3 h
Dipping (Control)[ns]	51.73 ± 0.30	48.43 ± 0.98	50.61 ± 3.72
Dipping 2 % HPMC[ns]	48.44 ± 2.80	52.17 ± 1.98	50.21 ± 1.68
Dipping & Dusting[ns]	48.32 ± 0.11	52.47 ± 0.99	54.44 ± 0.20
Dipping 2% HPMC & Dusting 2[ns]	47.97 ± 1.66	51.3 ± 2.22	51.55 ± 3.05

Note: [ns] mean within the same row are not significantly different ($p>0.05$)

Table 3 The a* value of fried chicken during 3 h storage

Treatment	0 h	2 h	3 h
Dipping (Control)	11.34 ± 0.75 [b]	12.65 ± 0.36 [a]	12.27 ± 1.63 [a]
Dipping 2 % HPMC	13.21 ± 0.95 [a]	11.21 ± 0.10 [b]	11.67 ± 0.65 [b]
Dipping & Dusting	15.08 ± 0.47 [a]	13.78 ± 0.23 [a]	13.46 ± 1.00 [a]
Dipping 2% HPMC & Dusting	13.71 ± 0.87 [a]	11.99 ± 1.54 [a]	12.64 ± 0.23 [a]

Note: [a–b] mean within the same row with different letters are significantly different ($p \leq 0.05$)

Table 4 The b*-value of fried chicken during 3 h storage

Treatment	0 h	2 h	3 h
Dipping (Control)	32.08 ± 2.06 [b]	33.22 ± 1.08 [a]	32.36 ± 0.69 [b]
Dipping 2 % HPMC	31.67 ± 3.62 [a]	30.95 ± 0.12 [b]	31.63 ± 1.24 [a]
Dipping & Dusting	37.56 ± 0.48 [a]	37.58 ± 0.31 [a]	36.70 ± 0.92 [a]
Dipping 2% HPMC & Dusting	33.77 ± 0.20 [b]	34.24 ± 0.37 [a]	34.19 ± 2.14 [a]

Note: [a–b] mean within the same row with different letters are significantly different ($p \leq 0.05$)

3.3 Effect of dipping and dusting before frying on moisture content of fried chicken

According to Figure 1, samples from the dipping and dusting treatment had a lower moisture content on curst than samples without dusting. Therefore, crust of the samples from the dipping and dusting treatment was possibly crispier than the samples without dusting. By adding HPMC in the batter without dusting, the moisture content on crust was decreased after 3 h storage. The moisture loss of crust might be due to heat in the warmer that enhanced moisture diffusion during storage. However, the moisture content in the chicken meat was not significantly changed, regardless of treatments before frying (Figure 2). This meant that moisture content of chicken did not move to the crust. Dipping and dipping & dusting could slow down water migration from chicken meat to the crust. As a result, the crispness of the fried chicken crust should be maintained during 3 h storage.

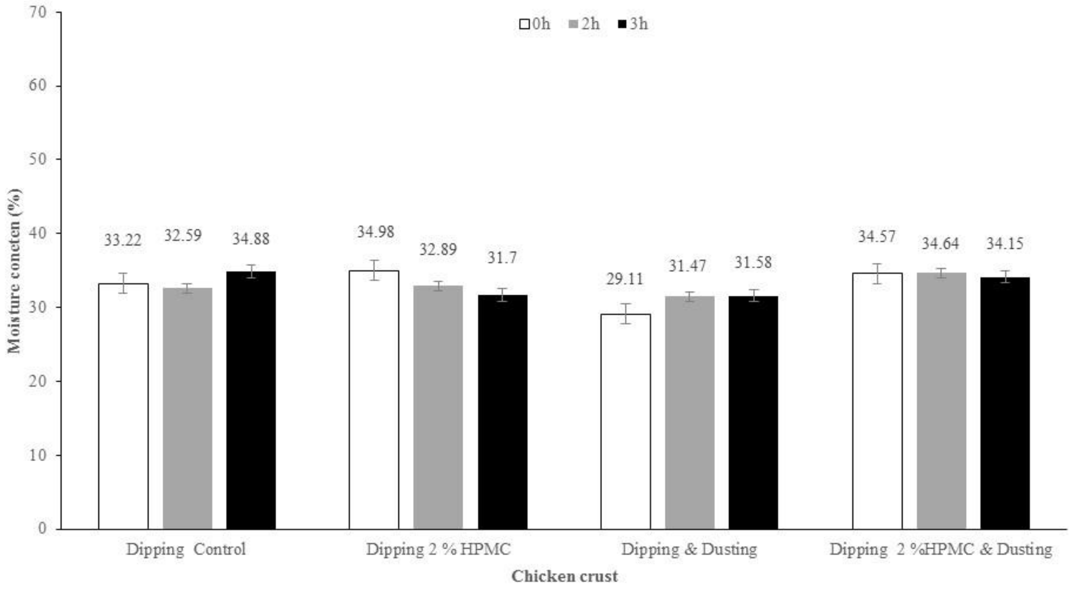

Figure 1 Moisture content in fried chicken crust during storage

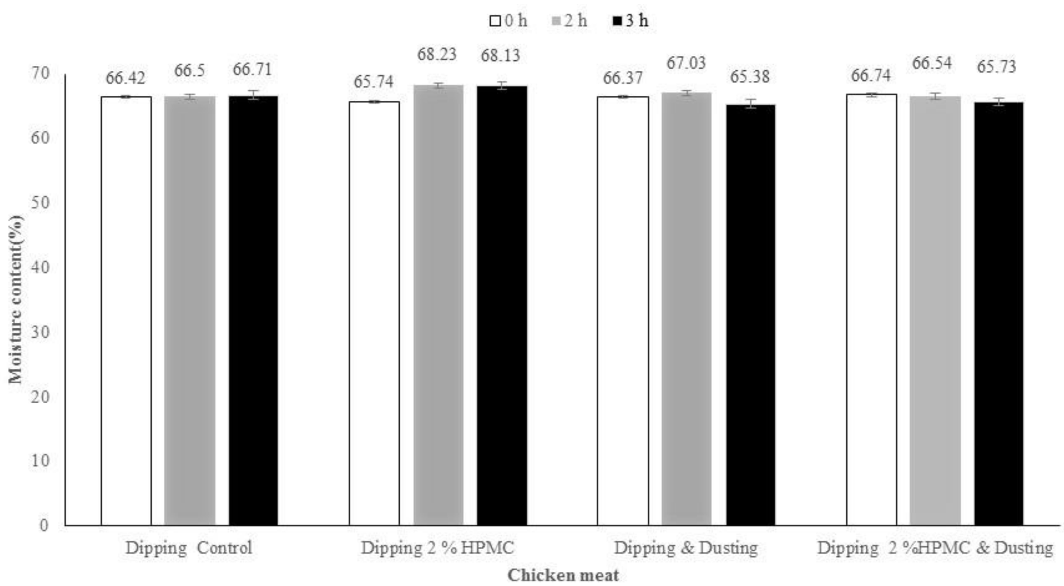

Figure 2 Moisture content in fried chicken meat during storage

3.4 Effect of dipping and dusting before frying on texture and sensorial quality of fried chicken

Considering in texture (Table 5), hardness of the fried chicken from almost all treatments (in exception of dipping without HPMC & dusting treatment) was not significantly changed during 3 h storage ($p \leq 0.05$). This was consistent with the result of moisture content in the crust and chicken meat during storage. From triangle test, samples from only dipping treatment were defined as “different” from the freshly fried product after 2 h storage. Dusting with wheat flour before frying could maintain crispness of the fried chicken crust for 3 h without significant difference from the freshly fried chicken (Table 6).

Table 5 Hardness (N) of fried chicken during storage

Treatment	0 h	2 h	3 h
Dipping (Control)	11.24 ± 0.28 ^{a}	11.33 ± 0.30 ^{a}	11.38 ± 0.20 ^{a}
Dipping 2 % HPMC	11.31 ± 0.42 ^{a}	10.63 ± 0.14 ^{a}	11.28 ± 1.05 ^{a}
Dipping & Dusting	11.52 ± 0.16 ^{b}	12.39 ± 1.08 ^{a}	13.84 ± 2.57 ^{a}
Dipping 2% HPMC & Dusting	11.96 ± 0.70 ^{a}	11.44 ± 0.32 ^{a}	11.35 ± 0.19 ^{a}

Note: $^{a–b}$ mean within the same row with different letters are significantly different ($p \leq 0.05$)

Table 6 Sensorial quality of the fried chicken by Triangle test

Treatment	2 h		3h		4 h	
	Correct	α (0.05)	Correct	α (0.05)	Correct	α (0.05)
Dipping (Control)	23/30	Sig	-	-	-	-
Dipping 2 % HPMC	20/30	Sig	-	-	-	-
Dipping & Dusting	11/30	Non-sig	12/30	Non-Sig	20/30	Sig
Dipping 2% HPMC & Dusting	13/30	Non-sig	15/30	Non-sig	18/30	Sig

4. Conclusion

In this study, a barrier of moisture migration was developed by the batter system in the fried chicken. In addition to dipping in the batter, a further dusting prior to frying chicken could increase and maintain crispness of the fried chicken storage at 50°C for 3 h. Therefore, chicken should be dipped in the batter containing 2% HPMC and dusted with wheat flour prior to frying at 170°C to obtain the crispy fried chicken that remained crispy for 3 h.

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