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# The effect of the addition of Carboxymethyl Cellulose (CMC) on the formulation of batters on Coating Pick up and Frying Loss fried battered Tempeh

[1*]Hanif Muchdatul Ayunda, [2]Safrida, [3]Afwa Hayuningtyas

[1]Nutrition Department, Universitas Teuku Umar, Indonesia, hanifmuchdatul@utu.ac.id
[2]Nutrition Department, Universitas Teuku Umar, Indonesia, safridam.si@utu.ac.id
[3]Nutrition Department, Universitas Teuku Umar, Indonesia, afwahayuningtyas@utu.ac.id
***Coresponding author**: Hanif Muchdatul Ayunda, e-mail: hanifmuchdatul@utu.ac.id

## ABSTRACT

One of the fried food processed products that is often found in roadside fried sellers is tempeh. This study aims to study the effect of CMC addition on the results of coating pick up dan frying loss of fried battered tempeh. Hydrocolloids used were carboxyl methylcellulose (CMC) and pectin with concentrations of addition to the batter as much as 0.3%, 0.5%, 1% of the overall weight of the mixture. Temperature and tempeh frying time is at a temperature of 180ºC and for 6 minutes. The results showed fried battered tempeh with the addition of CMC to its batters has good quality measured from the percentage of coating pick up samples.

## ARTICLE INFORMATION

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## Introduction

Currently coating food with hydrocolloids is very commonly done to maintain the quality of these foodstuffs. The addition of hydrocolloids in some studies has been shown to improve the quality of foodstuffs. The use of hydrocolloids develops consistency in *batter* formulations that causes high moisture binding activity and helps trap the evolved gases in the product. This results in an increase in the volume and texture of the fried product. There are various types of hydrocolloids that are often used in food including various types of gum, polyox, carbapol, PVP, and cellulose derivatives such as *carboxylmethyl cellulose* (CMC), *hydroxylprophyl methylcellulose* (HPMC), *methyl cellulose* (MC), *hydroxylprophylcellulose* (HPC).

Carboxyl Methyl Cellulose (CMC) is a type of natural hydrocolloid that has been modified into a cellulose ether derivative. CMC naturally can be derived from plant cellulose obtained by adding chloroacetic acid (Nussinovitch, 1997). CMC has the important functional property that it can increase viscosity that can be applied single-handedly or also mixed with other materials (Stelzer & Klug, 1980). CMC is referred to as a versatile hydrocolloid because it can dissolve in both hot water and cold water and can also dissolve in organic solvents (maximum 40% acetone and 50% ethanol). Generally, CMC foodstuffs are used ranging from 0.1-0.5% or generally less than 1% to obtain the functional properties of CMC as *thickening*, *stabilizer*, and *binding*. CMC has a molecular structure Figure 1.

According to Hsia *et al.* (1992) CMC's consistency in producing *batters* is excellent. Hydrocolloids have the ability to provide viscosity and can affect the uptake value of upholstered products. The higher the viscosity value of *batters*, the higher the adhesion level on the substrate (Dogan, 2004; Nasiri, Mohebbi, Yazdi, & Khodaparast, 2012). This is seen in the high pickup coating value of 1% CMC fabric with high viscosity (Chen, Chen, Chao, &Lin, 2009). Although CMC has no gelling properties, it significantly improves adhesion (Suderman & Cunningham, 1981).

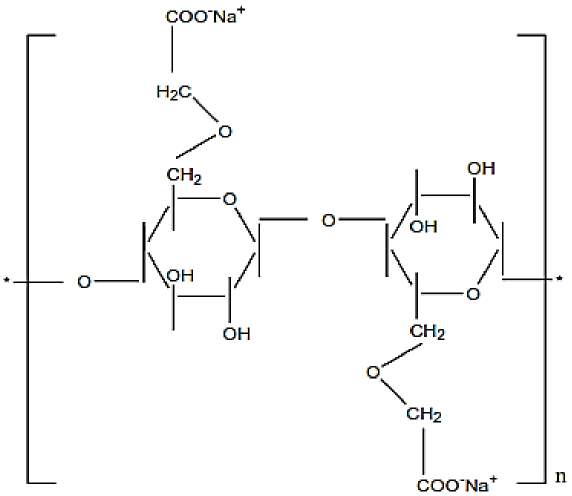


Figure 1. CMC Molecular Structure

This study aims to study the effect of CMC addition on the results of coating pick up dan frying loss of fried batered tempeh. The hypothesis put forward is that the addition of CMC in batter formulations has an effect on improving the quality of fried battered tempeh.

## Method

### Materials

Guilty tempeh from traditional markets in Bogor, commercial tempeh flour, cooking oil, CMC (food grade).

### Sample preparation

The tempeh used as the research material was cut uniformly with a size of 5x3 cm and a thickness of 0.5 cm using a knife. *Batters* used are a mixture of commercial tempeh flour, water and CMC with concentrations of 0%, 0.3%, 0.5%, and 1%. Tempeh is dipped in *batters* for 10 seconds and then fried using a deep fat fryer (Cecilware 107 Corporation; F210262; New York) at 180ºC and for 6 minutes with cooking oil. Fried battered tempeh samples analyzed their coating pick-up and frying loss.

### Coating Pick up and Frying Loss Analysis (Dogan, 2004)

Coating Pick up is the number of batters left on the sample after the sample is soaked in the batters formula. The tempeh sample that has been cut measuring 5×3×0.5 cm is weighed (Wa) then the sample is coated with *batter* and weighed (Wb) (Dogan, 2004), then calculated with the following formulation:

$$Coating\ Pick\ up\ (\%) = \frac{W_b - W_a}{W_b} x100\%$$

Frying Loss is the number of batters that are still attached to the sample after the frying process. The sample after going through the frying process is weighed (Wc) and calculated with the following formulations:

$$Frying\ Loss\ (\%) = \frac{W_b - W_c}{W_b} x100\%$$

### Statistical analysis

In this study used a complete randomized design. The treatment is repeated three times. Statistical analysis uses one-way ANOVA and further tested using dunnet test at 5% level using SPSS Statistics Version 22 software (SPSS Inc., Chicago, USA). In the Dunnett test, samples without the addition of CMC (0%) in the frying process were used as controls.

## Results

### Coating Pick Up and Frying Loss Fried Battered Tempeh

Coating pick up measurements are performed to confirm the adhesion indicator during the process of mixing the sample with batters, frying loss measurements are performed to confirm adhesion during the frying process to see how much of a percentage of weight is lost on the sample after frying. The number of batters attached to the sample and the batters that are further fried is measured in weight, so that a percentage comparison called coating pick up and frying loss is served in Table 1.

**Table 1.** the percentage value of coating pick-up and frying loss from fried battered tempeh

| **Commercial battered tempeh flour** | **Mean ± SD** | |
|---|---|---|
| | Coating Pick-up | Frying Loss |
| +CMC 0,3% | 29.04 ± 1.62 | 14.25 ± 0.81* |
| +CMC 0,5% | 28.09 ± 2.63 | 14.04 ± 1.32* |
| +CMC 1% | 32.66 ± 4.84* | 16.33 ± 2.42 |
| +CMC 0% | 18.52 ± 4.63 | 9.26 ± 2.31 |

* Values statistically highly significant on the significance of $p < 0.05$ by Dunnet Test

Fried battered tempeh products with the addition of CMC can be seen in Figure 2. The percentage of coating pick up samples with 1% CMC addition showed high results and statistically differed significantly from the controls that used the Dunnett test at a significance rate of 5%. The ability to enhance the acquired coating pick up is believed to be closely related to the ability of hydrocolloids to bind to structures free of other compounds in the material.

A negatively charged CMC binds to the+ positive charge of the protein, which can significantly increase the coating value of the pick-up. In the table above CMC ability in binding batters before frying is very high. The percentage of frying loss is related to the value of the coating pick up produced.

Figure 2. Fried battered tempeh products with the addition of CMC

Frying loss itself is measured to see how much the sample weight is reduced after the frying process. The more batters attached to the product, the fewer the remaining batters are wasted when frying, so it is expected that the value of batters is higher. The ability of the dough to attach to the product is a plus for the manufacturer as it minimizes the number of batters lost during frying of the product. Frying loss in the sample is indicated by calculating the shrinking weight of the sample during the frying process. Statistically the addition of CMC 0.3% and CMC 0.5% is very different from control. If the frying loss value is too high, more and more dough samples will be lost during the frying process. Frying loss can be affected by the sample's ability to absorb oil and moisture content (Suciati, Suradi, &Wulandari, 2015). Samples fried battered tempeh with the addition of CMC 1% occurs clumps during the frying process so that batters can't be attached to the tempeh perfectly. This causes the frying loss value to be high.

## Conclusion

Fried battered tempeh with the addition of CMC to its batters has good quality measured from the percentage of coating pick up samples. The addition of a 1% CMC concentration in batters increases the ability of coating pick up batters but the frying loss value is also very high due to the occurrence of clots when the sample is fried.

## References


Chen, S. Der, Chen, H. H., Chao, Y. C., & Lin, R. S. (2009). Effect of batter formula on qualities of deep-fat and microwave fried fish nuggets. *Journal of Food Engineering*, *95*(2), 359–364. https://doi.org/10.1016/j.jfoodeng.2009.05.016

Dogan, S. F. (2004). Effects of Different Batter Formulations on Quality of Deep Fat Fried Chicken Nuggets. *The Graduate School of Natural and Applied Sciences of Middle East Technical University*.

Hsia, H., Smith, D., & Steffe, J. (1992). Rheological Properties and Adhesion Characteristics of Flour-Based Batters for Chicken Nuggets as affected by Three Hydrocolloids. *Journal of Food Science*. https://doi.org/10.1111/j.1365-2621.1992.tb05414.x

Nasiri, F. D., Mohebbi, M., Yazdi, F. T., & Khodaparast, M. H. H. (2012). Effects of Soy and Corn Flour Addition on Batter Rheology and Quality of Deep Fat-Fried Shrimp Nuggets. *Food and Bioprocess Technology*, *5*(4), 1238–1245. https://doi.org/10.1007/s11947-010-0423-4

Nussinovitch, A. (1997). *Hydrocolloid applications: gum technology in the food and other industries*. Springer.

Saiful, M., Rani, A., Rudhziah, S., Ahmad, A., & Mohamed, N. S. (2014). Biopolymer Electrolyte Based on Derivatives of Cellulose from Kenaf Bast Fiber. *Polymers*, *6*(9), 2371–2385. https://doi.org/10.3390/polym6092371

Stelzer, G. I., & Klug, E. (1980). Carboxymethylcellulose. *Handbook of Water-Soluble Gums and Resins. McGraw-Hill, New York*, *4*.

Suciati, F., Suradi, K., & Wulandari, E. (2015). Pengaruh penggunaan berbagai jenis minyak nabati sebagai media pemanas terhadap daya serap minyak , kadar air , susut masak dan akseptabilitas daging ayam goreng. *Students E-Journal*, *4*(1). Retrieved from jurnal.unpad.ac.id/ejournal/article/download/5916/3105

Suderman, D., & Cunningham, F. (1981). Effect of Freezing Broiler Drumsticks on Breading Adhesion. *Journal of Food Science*, *46*(6), 1953–1953. https://doi.org/10.1111/j.1365-2621.1981.tb04529.x


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