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Effect of CMC levels on amount of oil uptake of potato French fries

Abstract

The objective of this study was to apply coating on potato at levels 1.5% of carboxy methyl cellulose (CMC) in order to reduce oil uptake in fried potato strips. With increase of consumer conscious, demand for low fat products has been increased. Concentration aqueous suspension of CMC with 1 and 1.5% were provided with batch number OC445231401 with code RG20 6 NE, UK. It was tested to select appropriate formulation for coating application. Potato varieties of local Greek were coated and uncoated samples were fried in temperature 180°C for 10minute with local sunflower oil. The obtained results showed that:1) The effect of coating with CMC due to their barrier properties, lead to decrease in potato weight loss of strips during frying and by respect to the % oil uptake at coated samples with 1.5% CMC were less than blank sample and CMC 1%. Percentage of weight loss potato was 24 and 12% for CMC 1% and CMC 1.5%. Thermal conductivity coefficients were 552 and 560watt/mk for above levels of CMC. But this different were not significant, while crust of thickness was siginificant and 4) the best coating were 1.5% CMC for low fat french fries potato production.

Keywords: oil uptake, French fries potato, CMC

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Introduction

One of the important quality attributes of deep fat fried products is the amount of oil content in these products. Fried food with low fat content, can hard texture edible coating have long been known to protect perishable food, from deterioration by retarding dehydration suppressing respiration, improving texture quality, helping to retain volatile flavor compounds and reducing microbial growth. Another application of edible films of coating is as barrier to lipid absorption by food during deep fat frying. Oil uptake in fried foods has become a health concern, high consumption of lipids been related to obesity and other health problem such as coronary heart disease. Reducing the fat content of fried food by application of coating is an alternative solution to comply with both health concerns and consumer preferences.[1,2] Food coating may become a good alternative to reduce oil uptake during frying, the effectiveness of a coating is determine by its, mechanical and barrier properties, which depend on its composition and microstructure and on the characteristics of the substract. Several hydrocolloids with thermal gelling or thickening properties such as proteins and carbohydrates have been tested to reduce oil and water migration. They also found that CMC films showed the best barrier properties, reducing fat uptake more than other hydrocolloids. CMC exhibit thermal gelation, temperature and the original suspension, viscosity is recovered. Thus, reducing the fat content of fried foods by application of coating is an alternative to comply with health concerns and consumer preferences.

Garcia C et al.,[3] investigated the effects of several hydrocolloid materials, including, gellan gum, CMC, pectin. Several groups were different effect on reduce oil migration. Hydrocollids with thermal gelling or thickness properties have been tested. Researchers resulted cellulose derivatives for coating formulations to reduce the oil uptake of fried products. The coating application did not modify either the texture characteristics or sensory properties of the fried samples. CMC coating formulations were the most effective, reducing the oil uptake by 35-40%, depending on the product.[4] The oil barrier properties of the coating depend on the formation of a uniform layer. Oil content is one of the important quality attributes in fried products. Fried potato products with low oil content have a hard and unfavorable texture.[5,6] On the other hand, high oil consumption is not cost-effective for manufacturers and products with high oil content are fatty and sometimes tasteless. Today, consumers are looking for food products with lower oil content. Therefore it is important to find the ways that can reduce the oil content of fried products.[7,8] The objectives of this study were to 1)Apply coating of CMC 1% and 1.5% CMC of potato strips in order to reduce oil uptake in fried potato strips. 2) To study effect of frying time on some physical properties of potato strips 3) to select appropriate formulation for coating application.

Material and methods

Preparation of suspension of CMC 1 and CMC 1.5%

CMC were provided with batch number OC445231401 with code RG20 6 NE, UK. Concentration aqueous CMC suspension of 1 and 1.5% were tested to select appropriate formulation for coating application.[2,9]

1. Potato variety of local Greek were purchased from market

Some physical properties of potatoes were as follows:

i. Dry matter-20%
ii. Color-Yellow
iii. Moisture-72%

2. Sunflower oil was supplied from market at Greece.

Some characteristics of sunflower oil were as follows:

i. Viscosity-62 (mpas)
ii. Surface tension-35(mN/m)

iii. Unsaturated fatty acid-83%

3. Statistical analysis was done with suitable soft ware.

Frying tests were performed with potato strips at two size (5cm diameter and 1cm thickness) and other size 1cm length, 0.5cm wide and 0.5cm thickness; samples were dipped in the coating suspension CMC 1% and CMC 1.5% for 3minute and immediately fried. Coated and uncoated samples were fried in temperature 180°C for 10minute with commerical sunflower oil. Potato weight loss was determined by measuring the weight of products before and after frying, Temperature of oil by thermometer, frying time by small chronometer. Lipid content, thickness of crust and thermal conductivity coefficient (K) also were measured.

Thermal conductivity was measured as follows

Sample preparation

The crust is withdrawn from french fries with a razor. The crust is stick on a teflon disk. The disk is 3millimeter thickness, and 2 centimeter diameter.

Method

The thermal conductivity coefficient is determined with the cool/hot tank method. The sample of French fries is put between two tanks. The two tanks are filled with water, one with hot water, which is around 50°C, the other with cool water, around 25°C. Magnet inside the tanks and magnetic agitator secure the homogeneity of the temperature in each tanks. An insolation system protects the tanks from outside variation. Thermocouples measure the temperature in the two tanks during the experiment. The experiments run during 1000second. The calculation of the heat flux transferred between those two tanks permit to determine the thermal conductivity coefficient of the sample.

Thickness of crust were determined as follows

Sample preparation

The crust is withdrawn from french fries with a razor. Then, the crust is put on micro slides, for microscope analysis.

Method

A digital camera is put on a microscope. The samples are put in the microscope, with different zoom and lightness. The zoom available are 5x, 10x, 40x and 100x.

Results and discussion

Cellulose derivatives were selected from experiments done with fried potato strips. Figure 1 showed that effect of frying time on potato weight losses. It was noticed that, potato weight loss percentage were 24 and 12% for 1 and 1.5% of CMC potato coated. Coating with CMC applied on potato strips reduced oil uptake and led to a higher retention of moisture content during deep fat frying. With increase of frying time, the potato weight loss was decreased. It was noticed that the increase of frying time (from 0 to 10min), the values of potato weight were decreased (from 50 to 28gm) and (from 50 to 31gm) for 1 and 1.5% CMC of potato strips.[10] Loss of potato weight were increased at CMC 1%, this was by increased oil absorption. We resulted that temperture of oil were 184°C and 179°C after 10minute of frying for CMC 1%, CMC 1.5%. Oil temperture were higher at CMC 1% than CMC 1.5% after 10minute of frying. Oil uptake increased at high oil temperture (Figure 2). We were seen thermal conductivity coefficient (K) not significant between CMC % 1 and 1.5% CMC. Thermal conductivity coefficient (K) were 579 and 642watt/mk for CMC 1% and CMC 1.5% respectively amount of K were higher at CMC 1.5% but at CMC was enough (Figure 3). Thicknesses of crust were studied also for 1% and 1.5% CMC and results showed that thickness were 1.5mm and 1mm for 1.5% and 1% CMC respectively (Figure 4). Final result, percent of oil uptake after 10minute of frying were 20.9% and 25.6% for CMC 1.5% and CMC 1% respectively, thus CMC 1.5% were the best of cover of frying for production of low fat french fries potato (Figure 5).

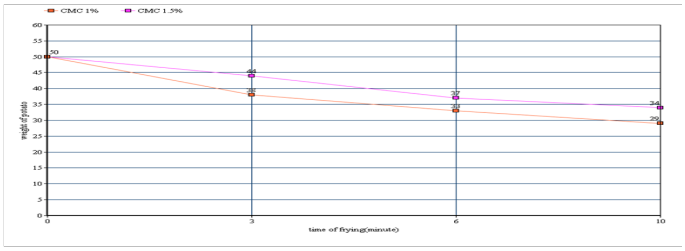

Figure 1 Relationship between frying time and potato weught losses for 1 and 1.5 CMC coated of potato at heated twemperature of oil 180°C.

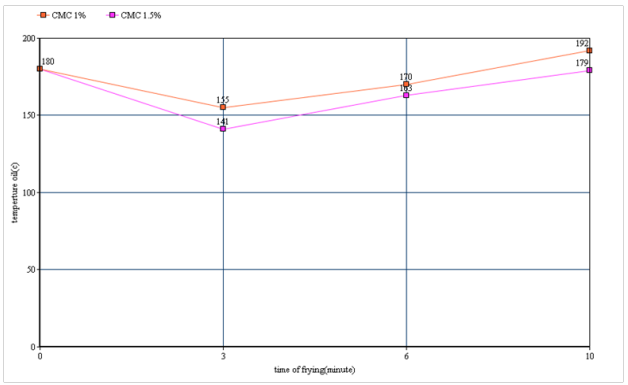

Figure 2 Relationship between frying time and temperature oil for 1 and 1.5 CMC coated of potato at heated temperature 179 and 180°C.

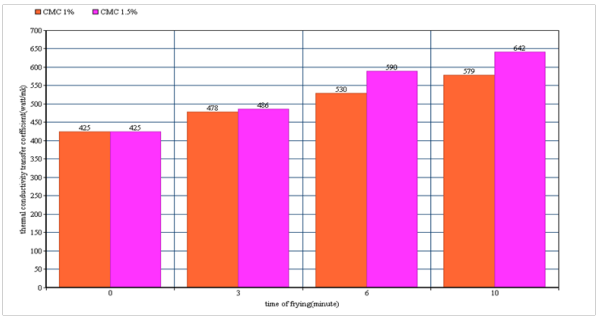

Figure 3 Relationship between frying time and thermal conductivity transfer for 1 and 1.5 CMC coated of potato at heated temperature of oil 180°C.

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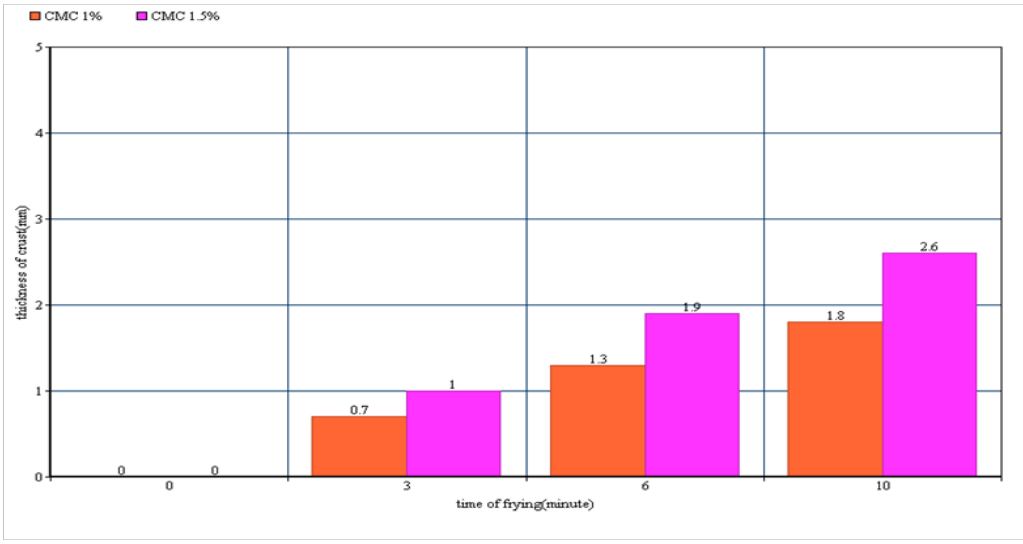

Figure 4 Relationship between frying time and thickness of crust for 1 and 1.5 CMC coated of potatoat heated temperature of oil 180°C.

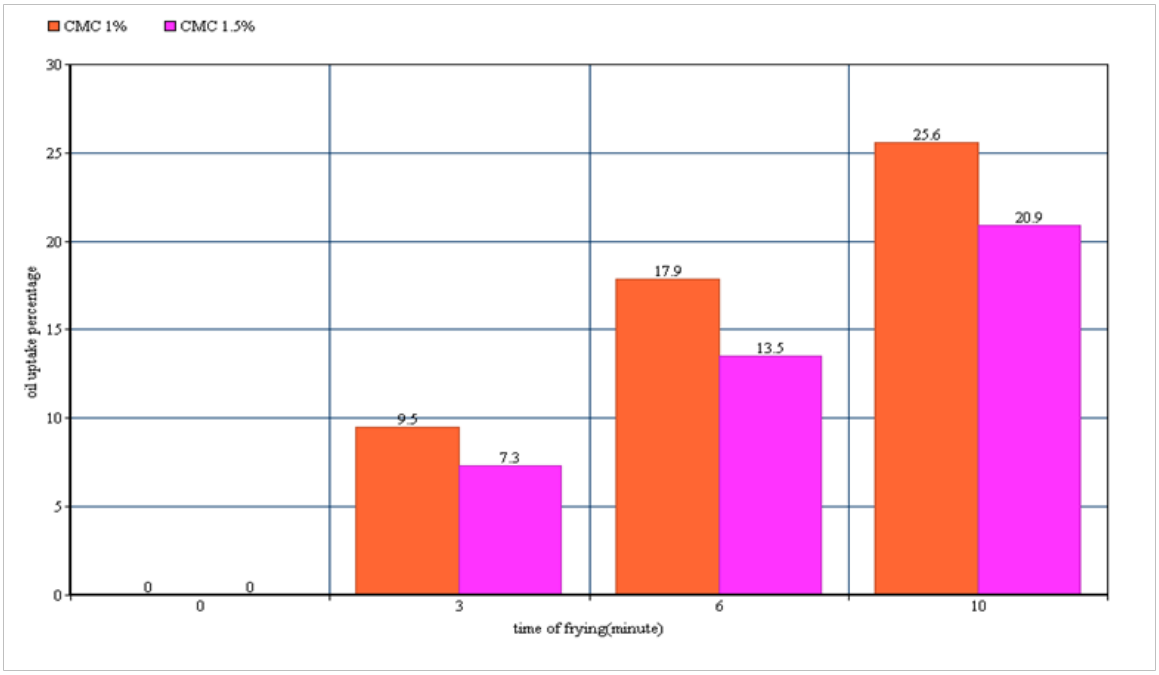

Figure 5 Relationship between frying time and oil uptake percentage for 1 and 1.5 CMC coated of potato at heated temperature of oil 180°C.

Conclusion

The concluded results were: 1) The effect of coating with CMC due to their barrier properties, lead to decrease in potato weight loss of strips during frying and by respect to the % oil uptake at coated samples with 1.5% CMC were less than blank sample and CMC 1%. 2) Percentage of weight loss potato were 24and 12% for CMC 1% and CMC 1.5%. 3) Thermal conductivity coefficient was 552 and 560watt/Mk for above levels of CMC. But this different were not significant, while, Crust of thickness was siginificant. 4) the best coating were 1.5% CMC for low fat French fries potato production. 5) With regard the results of fat content, CMC 1.5% was suggested as the best coating of French fries potato ($p<0.05$).

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Conflict of interest

The author declares no conflict of interest.

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