

# Role of mc compounds at less of oil absorption of French fries potato

## Abstract

Methylcellulose (MC) and hydroxypropylmethylcellulose (HPMC) were used in coating formulations to reduce oil uptake in deep-fat frying potato strips and dough discs. MC coatings were more effective in reducing oil uptake than HPMC ones. The effect of plasticizer addition (sorbitol) was also evaluated. The best formulations were 1% MC and 0.5% sorbitol for fried potatoes and 1% MC and 0.75% sorbitol for dough discs. For these formulations, oil uptake reduction was 40.6 and 35.2% for potato strips and dough discs compared to the uncoated samples; the increase in water content was 6.3 and 25.7%, respectively. Non-significant differences in texture of coated and uncoated samples were observed. Although instrumental color differences were detected, all samples were accepted by the non-trained panel. 2002 Elsevier Science Ltd. All rights reserved.

**Keywords:** edible coatings, cellulose derivatives, deep-fat frying, oil-uptake, doughnuts, potatoes

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**Abbreviations:** MC, methylcellulose; HPMC, hydroxy propyl methyl cellulose; HPC, hydroxy propyl cellulose; SPI, soy protein isolate

## Introduction

In deep-fat fried products, both health and sensory aspects should be addressed to meet consumer demand. Deep-fat frying is widely used to prepare tasty foods. The soft and moist interior together with the crispy crust are desirable characteristics of most fried foods.

Some fried products may contain fat up to 50% of the total weight. Some of these lipids were not in the food before frying. For example, lipid content of French fries increases from 0.2 to 14%, lipid content may reach 40% in potato chips; raw fish with 1.4% reach 18% fat after frying. Thus, oil uptake in fried foods has become a health concern. High consumption of lipids has been related to obesity and other health problems like coronary heart disease. Thus, pressure to restrict and select the sources of fat and oils has increased. Besides, a new goal to find products and or methods to reduce oil uptake during deep fat frying has appeared. Food coatings may become a good alternative to solve this problem. The effectiveness of a coating is determined by its mechanical and barrier properties, which depend on its composition and micro-structure, and by the characteristics of the substrate, as well.

Several hydrocolloids with thermal gelling or thickening properties, like proteins and carbohydrates, have been tested to reduce oil and water migration.<sup>1,2</sup> Adding food hydrocolloids as dry ingredients is a practical way to lower oil uptake of deep-fat fried foods, since the addition does not change conventional production procedures. Edible coatings at the surface of the foods comprise another possibility, but this technique has not been studied extensively. Balasubramaniam and Phillips<sup>3</sup> working with mashed potato balls reported a reduction, compared to uncoated balls, of 14.9, 21.9 and 31.1% in moisture loss and of 59.0, 61.4 and 83.6% in fat uptake for samples coated with corn zein, hydroxypropylmethyl-cellulose (HPMC) and methylcellulose

(MC) films, respectively. Williams and Mittal (1999) also found that MC films showed the best barrier properties, because it reduced fat uptake more than hydroxypropylcellulose (HPC) and gellan gum films applied to a pastry mix. They also reported difficulties to evaluate potato products.

Cellulose derivatives, including MC and HPMC exhibit thermogelation. When suspensions are heated they form a gel that reverts below the gelation temperature, and the original suspension viscosity is recovered. These cellulose derivatives reduce oil absorption through film formation at temperatures above their incipient gelation temperature, or they reinforce the natural barrier properties of starch and proteins, especially when they are added in dry form.

The objective of the present work was to apply coatings based on cellulose derivatives and plasticizer, to reduce oil uptake in French fried potatoes.

## Role of Mc compound at oil absorption

Overweight and body fat greatly increase the risk of adverse health consequences. Despite the shift in eating patterns to low-fat foods, especially those low in saturated fats to reduce the risk of heart disease, people still consume high levels of fried foods because they are more tasty and easier to prepare.

Ways of reducing fat absorption during frying are mentioned as below: use of pre-drying before frying, frying under high temperature and short-time conditions, and use of an edible film as coating agent. Thus, reducing the fat content of fried foods by application of coatings is an alternative to comply with both health concerns and consumer preferences. Susanne and Gauri investigated the effects of 11 hydrocolloid materials, including gelatine, gellan gum, k-carrageenan-konjac-blend, locust bean gum, methyl cellulose (MC), microcrystalline cellulose, pectin (three types), sodium caseinate, soy protein isolate (SPI), vital wheat gluten, and whey protein isolate. Their results showed that all coating agents reduced oil absorption in comparison to blank samples. Several groups have studied the

properties of different coatings to reduce oil migration. Hydrocolloids with thermal gelling or thickening properties, like proteins and carbohydrates, have been tested. Williams and Mittal found that MC films reduced fat uptake more than hydroxypropyl cellulose and gellan gum films applied to a pastry mix. Balasubramaniam et al.,<sup>3</sup> stressed that, in products coated with cellulose derivatives, a protective layer is formed on the surface of the samples during the initial stages of frying due to thermally induced gelation above 60 °C. This protective layer retards the transfer of moisture and fat between the sample and the frying medium. Garcia tested different 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. MC coating formulations were the most effective, reducing the oil uptake by 35–40%, depending on the product. The oil barrier properties of the coating depend on the formation of a uniform layer. CMC and its derivatives is characterized by its thermogelation properties; the gel formed upon heating above 60°C should melt once the sample reaches ambient temperature because thermogelation is a reversible process. The fact that a layer corresponding to the coating was seen after frying indicated that dehydration also took place on the coating. Absorption of oil on the surface of the fried product occurs when samples are removed from the frying medium, and the remaining oil enters into the product. The oil uptake does not happen to 100% after deep-frying. Approx. 20% of the total oil uptake takes place during deep frying and approx. 80% of the oil uptake happens after removing the fried products from the fryer. The conditions under which the potato slices are removed from the frying oil seem decisive for the uptake of oil.

## Results and discussion

The maximum moisture loss during frying was related to guar gum. Gums which can be placed on external surface of potato strips act as a barrier to moisture removal during frying and so, reduced the moisture loss of French fries. Generally, coating with hydrocolloids increased the moisture content of final products compared with uncoated samples which is in agreement with the results reported by Aminlari M et al.,<sup>1</sup> AOAC<sup>2</sup> Balasubramaniam VM et al.,<sup>3</sup> The highest and lowest moisture content was observed respectively for the French fries coated with 1.5% xanthan gum and 0.5% pectin gum. Different gums led to different water increase in fried strips but this differences were not significant ( $P>0.05$ ). Increase in water content due to coating, may be result of barrier properties of coating agents which prevent water loss during frying and by this mechanism water content of coated strips were higher than non coated strips. Water content of coated stripes was higher than non coated strips. Different gums due to different barrier properties and different gel formation ability led to different water retention in fried product. Indeed these properties related to gums structure and its functional groups.<sup>4-7</sup> Different gums led to different decrease in amount of oil absorption in final products. Among different gums that used in this study as a single layer coating, mixture of pectin and CMC 1% and xanthan gum 1.5% led to highest decrease in fat content and the lowest decrease in amount of fat absorption was observed in pectin gum 0.5% and guar gum 0.5% respectively. Coating with xanthan gum in all concentrations showed the high decrease in fat content. Coating with mixture of pectin and CMC in both concentrations also led to higher decrease in fat content of fried strips, this can be due to synergistic effect of tow gums on each others. Mixture of pectin and CMC gums in both concentrations decreased fat content more than each of them that used alone. Our Result showed that, by increase of gums concentration fat content, decreased. Also, all the coated samples had a lower oil uptake than

uncoated samples which was significantly different ( $p<0.05$ ). This can be due to lower moisture loss of coated samples during frying and therefore, lower oil uptake. Our results revealed that samples coated with xanthan, guar and CMC gums required a lower amount of force for cutting. Studied by Somsen D,<sup>8</sup> Van de Velde F et al.,<sup>9</sup> have shown that final texture of a fried product is slightly dependent on its composition. In fact, interaction between protein and starch (amylose and amylopectin) is important for the quality and texture of final product. Hence, pectin and mixture of pectin and CMC can react with the cell wall constituents (calcium) of potato and lead to a harder texture which requires a higher force for cutting ( $p<0.05$ ). Regarding color, the highest L value was observed in coated samples with 0.5% CMC and mixture of 0.5% CMC and 0.5% pectin while the lowest L value was related to coated samples with 0.5% pectin which significantly different with uncoated sample ( $p<0.05$ ). Other gums didn't have a significantly different L value compared with uncoated samples. Our results showed that coating of French fries with different layers of hydrocolloids reduced the moisture loss of products during frying because of their barrier properties. Since moisture removal during frying is a key factor for oil uptake of fried products, coated samples have significantly lower oil uptake than uncoated ones. For single-layer coating, 0.5% CMC, the mixture of CMC and pectin (0.5 and 1%), guar 0.3% and xanthan (in all concentration) produced fried products with the lowest oil uptake. From these gums, CMC and the mixture of CMC and pectin is recommended for single-layer coating and the other gums, particularly xanthan, are not favorable because their solution have a high viscosity and cannot coat the products uniformly. Considering double and triple-layer coating, although they can reduce the oil uptake, but they not recommended for some of fried products such as chips and French fries neither which are expected to have a tender structure, because these coated products have high moisture content nor a tender texture. Double and triple-layer coating can be used for the production of low fat products.

## Conclusion

With regard to the results of fat content and index value, CMC 1% was the best gum for coating, but with respect to sensory evaluation, tragacanth 2% was the best treatment. By considering both results of oil uptake and sensory evaluation, CMC 1% was suggested as the best gum for coating potato chips ( $p,0.05$ ).

Our results showed that coating of French fries with different layers of hydrocolloids reduced the moisture loss of products during frying because of their barrier properties. Since moisture removal during frying is a key factor for oil uptake of fried products, coated samples have significantly lower oil uptake than uncoated ones. For single-layer coating, 0.5% CMC, the mixture of CMC and pectin (0.5 and 1%), guar 0.3% and xanthan (in all concentration) produced fried products with the lowest oil uptake. From these gums, CMC and the mixture of CMC and pectin is recommended for single-layer coating and the other gums, particularly xanthan, are not favorable because their solution have a high viscosity and cannot coat the products uniformly. Considering double and triple-layer coating, although they can reduce the oil uptake, but they not recommended for some of fried products such as chips and French fries neither which are expected to have a tender structure, because these coated products have high moisture content nor a tender texture. Double and triple-layer coating can be used for the production of low fat products.

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## Conflict of interest

Author declares that there is no conflict of interest.

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