

Effect of blanching and coating with hydrocolloids on reduction of oil uptake in french fries

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Abstract: The French fries were prepared from potatoes after pretreating with water, CaCl₂ and citric acid and then coating with different hydrocolloid solutions. It was observed that French fries pretreated with 0.5% aqueous solution of CaCl₂ and coated with 1% aqueous solution of HPMC resulted better product in moisture retention and oil uptake than the French fries with other hydrocolloids (MC, guar gum and xanthan gum). However, the French fries pretreated with 1% aqueous solution of citric acid and coated with 1% aqueous solution of HPMC resulted in better sensory quality than the fries with other hydrocolloids.

Keywords: Pretreatments, hydrocolloids, French fries, oil uptake, sensory parameters

Introduction

French fries are a popular snack food made from potatoes. Potatoes are sliced to make sticks, deep fried in vegetable oil, seasoned and served with tomato chili sauce. The potato products such as French fries, chips, balls etc. are also fried products which absorb high amount of oil. These products though taste good, pose health problems due to high calorie and cholesterol intake. The people now become health cautious and demand for less dense and low calorie foods.

Frying is a process of cooking and drying through contact with hot oil and it involves simultaneous heat and mass transfer. Deep fat frying of various kinds of foods coated with batter is a popular cooking procedure in many countries (Kimber and Holding, 1987), wherein the heat is transferred from oil to the product, water is evaporated and oil is absorbed. Crust formation and browning also take place giving the product an attractive golden appearance and crispy mouthfeel (Annapure *et al.*, 1998). The amount of oil uptake is directly proportional to the amount of moisture lost (Gamble and Rice, 1988). The oil uptake and its distribution in the fried product is mainly near the surface i.e. crust (Varela, 1988) and fried potatoes absorb 15% oil during frying (Toma *et al.*, 1986). To make such product more acceptable to the health cautious consumers, the oil uptake should be reduced either by use of fat replacers such as fat mimetics, low calorie fats and fat substitutes. Another approach is to use edible ingredients in the batter to improve coating performance and blending of cereals and legumes (Annapure *et al.*, 1999). The hydrocolloids are widely used in many food formulations to improve quality attributes and

shelf-life (Saha and Bhattacharya, 2010). The use of hydrocolloids in the food industry has become very common in the last few decades. Various ingredients such as pectin, sodium alginate (Khalil 1999; Holikar *et al.*, 2005), powdered cellulose (Mallikarjunan *et al.*, 1997; Annapure *et al.*, 1999; Sakhale *et al.*, 2011) and corn zein (Feeney *et al.*, 1993) were attempted.

The objectives of present study was to know the effect of blanching and coating with edible agents such as hydroxypropyl methyl cellulose (HPMC), methyl cellulose (MC), guar gum and xanthan gum on moisture retention, oil uptake and sensory quality of French fries.

Materials and Methods

The fresh potato tubers (*Solanum tuberosum* L.) were washed, peeled with potato peeler and cut manually into 8 x 8 x 60 mm strips. The strips were divided into nine lots. The first lot was only water blanched at 85°C for 6 min, drained and dried in a convection oven at 150°C for 3 min to reduce the surface moisture and treated as T₀ (control). This treatment was not neither given chemical blanching treatment nor coated with any of the hydrocolloids used. The second, third, fourth and fifth lots each were blanched in 0.5% aqueous solution of CaCl₂ and then coated with 1% aqueous solution each of HPMC, MC, guar gum, xanthan gum, respectively for 2 min, drained and then dried in convection drier as above. Similarly sixth, seventh, eighth and ninth lots of each were blanched in 1% aqueous solution of citric acid and then coated with 1% each of HPMC, MC, guar gum, xanthan gum, respectively for 2 min, drained and then dried in convection drier as above. Accordingly the lots were given the treatment number

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from T₀–T₈, respectively, as detail below.

T₀ (water blanching), T₁, T₂, T₃ and T₄ (blanching in 0.5% CaCl₂ and coating with 1% each of HPMC, MC, guar gum and xanthan gum, respectively). T₅, T₆, T₇ and T₈ (blanching in 1.0% citric acid and coating with 1% each of HPMC, MC, guar gum and xanthan gum, respectively).

The blanched and hydrocolloids treated samples were deep fried in a pan of three liter capacity in refined vegetable oil (1:6 strips: oil ratio). The oil was changed every after frying of each lot. The fried strips were allowed to cool at room temperature and analyzed for moisture retention and oil up take. The oil uptake was determined with Soxhlet extraction apparatus using petroleum ether (40-45°C BP) and moisture was determined using Simadzu make MOC-120 rapid moisture analyzer. The French fries were evaluated for sensory quality for appearance, color, taste, texture and overall acceptability by a semi-trained panel of 10 judges on 9 point Hedonic scale (1- extremely dislike, 9- extremely like) (Amerine *et al.*, 1965). The scores obtained for various quality parameters were recorded and average values of triplicate observations are reported.

Results and Discussion

Moisture loss and oil uptake

The data on moisture and oil contents of French fries (Table 1) revealed that the product when pretreated with either 0.5% aqueous solution of CaCl₂ or 1% aqueous solution of citric acid and coated with 1% aqueous solution of HPMC (T₁, and T₅ respectively) retained highest moisture (37.45 to 37.60% respectively) in the product. It is known that the HPMC forms a film on the product and decrease the tendency of the product to absorb the oil and lose moisture. The mass transfer ceases to occur. The oil content of French fries decreased considerably with pretreatments and addition of hydrocolloids, irrespective of the type of hydrocolloids as compared to control. In the present study this holds good and French fries retained more moisture and taken up less oil. The moisture retention of control (T₀) was lowest (32.45%) than any of the other samples which indicated that it was only pretreated with hot water and not coated with any of the hydrocolloids and sufficient mass transfer might have occurred. The French fries when pretreated with either 0.5% aqueous solution of CaCl₂ or 1% aqueous solution of citric acid and then coated with 1% MC, 1% guar gum or 1% xanthan gum solutions resulted in higher moisture retention and less oil uptake than the control one indicating thereby that mass transfer was also

less in these treatments (T₂, T₃, T₄, T₆, T₇ and T₈) than the T₀ (control).

Table 1. Effect of pretreatments and coating of hydrocolloids on moisture content and oil uptake of French fries*

Sample Treatments	Moisture, %	Oil, %	% Reduction in oil uptake
T ₀ (Control)	32.45	26.4	-
T ₁	37.45	14.0	46.9
T ₂	35.51	18.6	29.5
T ₃	34.37	21.4	18.9
T ₄	33.17	24.8	6.1
T ₅	37.60	16.4	37.8
T ₆	36.12	19.4	26.5
T ₇	33.68	23.6	10.6
T ₈	33.02	25.4	3.8
Mean ± SD	34.82±1.15	21.11±0.43	15.43±0.81

*Each value is the average of three determinations.

One of the most important properties of hydrocolloids is their ability to form films and sheets and act as a very effective barrier to oil and therefore used in number of food applications including adhesion, film forming, thermal gelling and non charring characteristics. The film forming characteristics of these hydrocolloids have prevented the absorption of oil and at the same time helped to retain the natural moisture of foods. This could be the reason of using these hydrocolloids in deep frying of fried products (Ang, 1993; Koelsch and Labuza, 1992; Mallikarjunan *et al.*, 1997; Williams and Mittal, 1999; Sakhale *et al.*, 2011). The reduction in oil uptake by French fries was lowest 46.9% and 37.8 % in T₁ and T₅ treatments respectively which might have been due to more film and sheet formation by HPMC which acted as effective barrier to oil. Khalil (1999) reported 40% reduction in oil uptake when he coated French fries with 0.5% calcium chloride and 5 % pectin. However, Sakhale *et al.* (2011) also reported the significant reduction in oil content in *Samosa* (8.56%) prepared with addition of xanthan gum at 1.5% level as compared to other hydrocolloids (HPMC, CMC, guar gum) and their concentration levels.

Sensory quality

Sensory quality is an important aspect in considering the overall acceptability of food product. Deep fat frying is widely used in industrial preparation of foods, because consumers prefer the taste, appearance, and texture of fried food products (Saguy and Pinthus, 1994). Effect of pretreatments and coating of hydrocolloids on sensory quality of French fries were studied and the scores obtained with respect to various sensory attributes are presented in Table 2. When pretreatments were given, the French

fries might be hampered the taste, odor, mouth feel, color or aroma of the product. The blanching step previous to frying in potato chip processing improved the color and texture as reported earlier by Califano and Calvelo (1987). The appearance and color of French fries improved by pretreatment with either calcium chloride or citric acid and coating with HPMC. The overall acceptability was also improved in these treatments (T_1 and T_5) which could be probably because of improvement in other sensory quality parameters such as taste, texture, color and appearance. It is reported that hydrocolloids are used to improve the texture and moisture retention in cake batters and dough, to increase the volume and shelf life of cereal foods by limiting starch retrogradation, improve their eating quality and appearance (Kohajdova and Karovicova, 2009; Kotoki and Deka, 2010).

Table 2. Effect of pretreatments and coating of hydrocolloids on sensory quality of French fries*

Sample treatments	Appearance	Color	Taste	Texture	Overall acceptability
T_0 (Control)	8	7	8	7	8
T_1	8	8	7	8	8
T_2	7	7	8	7	7
T_3	8	7	6	7	7
T_4	6	6	6	6	6
T_5	9	8	7	8	8
T_6	7	7	7	7	7
T_7	6	7	7	8	7
T_8	6	6	6	6	5

*Each value is the average of ten determinations.

Conclusion

Among all the hydrocolloids studied at different levels for preparation of French fries, it can be concluded that potato French fries pretreated with either 0.5% calcium chloride or 1% citric acid and coated with 1% HPMC were found better in both oil uptake and sensorial quality characteristics. Thus, French fries with reduced oil and low calorie content with better acceptance can be prepared in order to meet the demand of low fatty foods of health cautious consumers.

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