Effect of Frying Temperature on Amount of Oil Uptake of Potato French Fries

Abstract
Fat uptake and characteristics crispy texture are main quality parameters of fried potato products such as the most popular French fries and potato crisps. They are formed during the frying conditions were taken under investigation. Quality of frying oils as well as fatty acid composition and degree of degradation affect fat uptake and texture of fried potato products such as French fries and potato crisps are discussed. The kind and quality of frying medium as well as frying parameters (temperature) influence fat uptake and texture of fried potato. Texture of products correlated with fat content and composition of frying medium. Higher frying temperature decrease hardness of French fries and potato crisps which exhibit more crispy and delicate texture in composition with products fried at lower temperature. In this research, the effect of frying temperature at temperatures 180°C and 160°C for less of oil uptake of French fries were studied. Results showed that temperature of frying 180°C had more fat uptake than 160°C. By this respect the highest and lowest of oil uptake were 28% and 23% which related 180°C and 160°C frying temperature. Thermal conductivity coeffient were 750 and 500 w/mk for temperature 180°C and 160°C respectively, this difference were significant (p<0.05). Thickness of crust and oil were 1.5 and 3.1 mm for temperatures 160°C and 180°C respectively that were significant difference (p<0.05). At last temperature of frying 160°C at 10 minute were recommended for low fat French fries potato production.

Keywords: Oil uptake, Temperature of frying, French fried potato

Introduction
Potato (solanum tuberorum) is a tetraploid plant which belongs to solanum species and solmaceace family. This crop with world production of 400 million ton is the most important agricultural crop after wheat, corn, and rice. Deep fat frying is a dry cooking process which is mainly immersing food pieces in hot vegetable oil. During the frying process, physical, chemical and organoleptic properties of food changed, the main goal of deep fat frying is to maintain tenderized and crispy shapes. Oil content is one of the important quality attributes in fried products [1]. Fried potato products with low fat content have a hard and unfavourable texture. On the other hand high oil consumption is not cost-effective. For manufacturers and consumers products with high oil content are high fatty acid and tasteless. Today consumers are eating food products with lower fat content [2]. Oil absorption during deep fat frying is controlled by parameters including oil quality, frying temperature and time. Deep-fat frying is one of the oldest processes of food preparation which consists basically in immersion of food pieces in hot vegetable oil. The high temperature causes partial evaporation of the water, which moves away from the food and through the surrounding oil [3]. Oil is absorbed by the food, replacing some of the lost water. Several procedures have been proposed to reduce the oil absorbed. Low frying temperature or excess loading the fryer can decrease the oil uptake [4]. When the temperature of frying is high, it takes more time to have the favorable color and flavor in the product which leads to higher oil uptake. Since moisture removal during frying is a key factor for oil uptake of fried products, low temperature have significantly lower oil uptake than high temperature [5]. The determination of the exact instant that frying oil must be replenished is a major concern for avoiding possible health risks [6]. By considering this, we aimed at finding the best temperature of frying which can be processed into french fries with lower oil content.

Material and methods
Sample preparation
Potatoes were supplied from local market of greece. After peeling with an abrasive peeler; samples were converted to pieces two shapes with diameter 5 cm and thickness 1 cm. Other shapes were 1 cm (length) 0.5 cm wide and 0.5 cm thickness. Samples were fried at two temperatures 180°C and 160°C for 10 minute. In order to curve weight of potato and temperture of oil with time of frying and conductivity coeffient and thickness of crust and oil uptake percent were measured [7,8].

Fryer model HD6103 phils
Sunflower oil were prepared from local market of greece.

Statistical analysis was compared using the Duncan test at 5% significant level using with SAS soft ware.

Thickness of crust measurement
a. Sample preparation
The crust is withdrawn from french fries with a razor. Then, the crust is put on micro slides, for microscope analysis.
b. 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

Our results revealed that temperature of frying at 180°C had more oil uptake than temperature temperature of 160°C. As it can be seen in figure 1, potato weight (gm) were increased with increase of frying times, at time of frying 10 minute potato weight of potato were reached minimum. For two size of potato, weight loss % were 64% and 58% for frying temperature of 180°C and 160°C respectively with significant difference (p<0.05) [9]. Similar results were obtained at frying temperature 160°C and 170°C. On the other hand, loss of water is expected for two temperature but result of other researchers was for other variety of potato and less time of frying. This result was significant (p<0.05). In figure 2, temperature of oil at first decreased until 3 minute of frying and increased from 3 to 10 minute for two temperatures 180 and 160°C, but were more at 180°C. This difference were non significant (p>0.05). Our result showed that temperature of oil was higher 180°C than 160°C of frying. Thus oil uptake was higher at temperature of 180°C (p<0.05). Considering crust evaluation, temperature of 180°C were related the highest thickness at 10 minute of thickness were 1.5 and 3.1 mm for 160°C and 180°C respectively this different were significant (figure 3). Although thickness of crust was higher at 190°C but at 160°C was enough. Thermal conductivity coefficient were 750 and 500 wat/m°C for 180°C and 160°C respectively, which were significant. At last, we resulted the best temperature of frying were 160°C for 10 minute for production of low fat french fries potato. Oil uptake % were 28% and 23% for 180°C and 160°C respectively (p<0.05) (figure 4).
Conclusion

Our results showed that since moisture removal during frying is a key factor for oil uptake. Considering temperature of 180°C were more oil absorption than temperature of 160°C. But we were recommended 160°C frying temperature because had suitable texture, although temperature 180°C had high thickness of crust but contain high fat uptake %. Thus temperature of 160°C were better because low of oil uptake and enough thickness of crust.

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