

Effect Of Frying Time And Temperature On The Oil Uptake Characteristics Of Pre-Treated Potato (*Solanum Tuberosum*) Chips

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Abstract

The study was conducted with objective to find the combine effect of frying time and temperature with combination of pretreatment (blanching temperature) on the oil uptake characteristics of potato chips. The study was conducted using three levels of frying time (30, 60 and 90 seconds) and three levels of frying temperature (170, 180 and 190^oc) in combination with three blanching temperature (70, 80 and 90^oc). And unblanched samples were used as control samples and all samples either blanched or unblanched were dried for 30 minutes at 70^oc. Oil uptake was lowest 20.60 % for the sample fried at 190^oc for 90 seconds and blanched at 90^oc and highest 46.40 % for unblanched sample fried at 170^oc for 30 seconds.

Keywords: *Frying time, Frying Temperature, Blanching Temperature, Oil Uptake,*

1. Introduction

Potato (*Solanum tuberosum*) is a starchy, tuberous crop of Solanaceae family. Potato is semi perishable in nature, it contains about 80% water and 20% dry matter. A major portion of dry matter is starch and sugar that constitutes 16% on the fresh wet basis, crude protein is 2% (Singh *et al.*, 2007). It is one of the world's major agricultural crops with worldwide production in excess of 300 million tons/year, a figure exceeded only by wheat, maize and rice (Pedreschi, Moyano, Kaack & Granby, 2005).

Potato chips are described as thin potato slices (thickness less than 2 mm) that are dehydrated by deep fat frying to moisture content of 2% or less (Baumann & Escher,

1995). Frying in hot oil at temperatures between 160 and 180 °C is characterized by very high drying rates that ensure favourable structural and textural properties (Baumann & Escher, 1995). Deep-fat frying is a complex unit operation involving high temperatures, significant micro structural changes both to the surface and the body of the chip, and simultaneous heat and mass transfer resulting in flows in opposite directions of water vapour (bubbles) and oil at the surface of the piece (Bouchon *et al.*, 2003).

Frying time and temperature are processing variables that the manufacturer manipulates in order to produce optimum quality chips and depends on the raw potato composition and slice thickness (Moreira *et al.*, 1999; Gamble & Rice, 1988). These frying variables influence the texture (Miranda *et al.*, 2005), final oil content (Baumann & Escher, 1995) colour and flavour (Pedreschi *et al.*, 2005). It is reported that higher temperatures yield chips with less oil than lower temperatures since hotter oil has a lower density and is not adsorbed as easily whereas lower frying temperatures require longer frying times, allowing the chip surface to absorb more oil (Saguy *et al.*, 1998).

U.Kaushik *et al.*,(2014) studied the effect of pre-treatment like blanching conditions of time and temperatures on the oil uptake and textural property of hardness of chips prepared from elephant foot yam and found the condition of 80 degree Celsius blanching for 8 minutes with frying oil temperature of 160 degrees had the least oil uptake among all the treatment conditions.

The overall size of the snack food market is estimated at Rs 45 to Rs 50 billion. The market is reported to be growing at 7 to 8 % annually. Potato chips are estimated to constitute nearly 85% of India's total salty snack food market of about Rs 2,500 crore. In the Rs 19 billion

branded(organized)snacks market, constituting over 40% of the market by value, Frito-Lay is estimated to command a market share of 45%, followed by Haldiram at 27% and ITC at 16%. The branded snacks market accounted for 16% by value and 12% by volume sales in 2007.

2. Materials and Method.

2.1 Sample Preparation

The potato of a particular cultivar was purchased from the local market taking due care that it was in a good shape and condition, not affected by damage and spoilage. After procurement the raw material was adequately washed to remove soil and dust adhering on the surface. After that the potatoes were peeled with potato peeler and washed again for subsequent slicing. The slices were then washed thoroughly in order to remove the excess starch on the surface. Then blanching of all the samples was done at three temperature levels of 70, 80 and 90°C for 5 minutes in a hot water bath which is thermostatically controlled. After blanching the samples were immediately cooled to prevent over blanching in normal water. Then the sample were evenly spread on the trays and kept inside the tray drier for drying. The samples were dried at 70°C until reaching moisture content of 8.78±0.6 wet basis. After drying the samples were fried in a deep fat fryer which is thermostatically controlled at the frying oil temperatures of 170, 180 and 190°C. Refined soyabean oil was used as the frying oil. After deep fat frying samples were taken out and allowed to cool. After cooling they were packed in aluminum pouches and stored for further analysis.

2.2 Sample Analysis Sample analysis involved the analysis of the oil uptake, colour and the texture of each sample. The oil uptake for each sample was measured with the help of a Soxhlet apparatus. And the colour was measured with the help of Hunter L*a*b* colorimeter and values represented in the form of L*a*b*. Textural was measured in terms of hardness and analyzed with a texture analyzer-Texture Exponent Lite, version 4.0,13.0 Texture Analyzer using a spherical probe which displays the response in the form of a force versus time graph.

3. Results and Discussions

3.1 Effect of frying time and temperature on oil uptake of potato chips.

3.1.1 Effect of frying time on oil uptake of potato chips

3.1.1.1 Effect of frying time on the oil uptake fried at 170°C and blanched at 70°C.

The potato chips were pretreated with hot water blanching at a temperature of 70°C for 5 minutes. Potato chips were fried at 170°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 2.01gm fried for 30 seconds, 1.98 gm fried for 60 seconds and 1.96 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm. The fat content was found 40.2gm/100 gm (i.e. 40.2 %), 39.6gm/100gm (i.e. 39.6 %) and 39.2 gm/100 gm (i.e. 39.2 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 40.20 gm to 39.20 gm per 100 gm. The graphical representation (fig.3.1.1) shows a linear relationship ($R^2=0.986$) for the samples blanched at 70°C for 5 minutes and fried at temperatures of 170°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.1

$$Y = -0.025X + 2.033 \text{ --- Eqn. (3.1.1.1)}$$

3.1.1.2 Effect of frying time on the oil uptake fried at 180°C and blanched at 70°C.

The potato chips were pretreated with hot water blanching at a temperature of 70°C for 5 minutes. Potato chips were fried at 180°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.93 gm fried for 30 seconds, 1.91 gm fried for 60 seconds and 1.88 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm. Fat content was found 38.60 gm/100gm (i.e. 38.6%), 38.20 gm (i.e. 38.2 %), 37.60 gm/100gm (i.e. 37.6 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 38.60 gm to 37.60 gm per 100 gm. The graphical representation (fig.3.1.1) shows a linear relationship ($R^2=0.986$) for the samples blanched at 70°C for 5 minutes and fried at temperatures of 180°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.2

$$Y = -0.025X + 1.956 \text{ --- Eqn. (3.1.1.2)}$$

3.1.1.3 Effect of frying time on the oil uptake fried at 190°C and blanched at 70°C.

The potato chips were pretreated with hot water blanching at a temperature of 70°C for 5 minutes. Potato chips were fried at 190°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.85 gm fried for 30 seconds, 1.83 gm fried for

60 seconds and 1.81 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm. The fat content was found 37 gm/100gm (i.e. 37 %), 36.6 gm (i.e. 36.6 %), 36.2 gm/100gm (i.e. 36.2 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively.

The graphical representation (fig.3.1.1) shows a linear relationship ($R^2=1$) for the samples blanched at 70°C for 5 minutes and fried at temperatures of 190°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.3

$$Y = -0.02X + 1.87 \quad \text{- Eqn. (3.1.1.3)}$$

The graphical representation for the samples blanched at 70°C and oil uptake is shown in figure 3.1.1

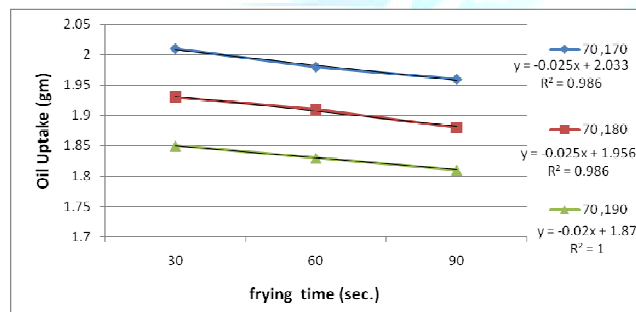


Fig-3.1.1 Effect of frying time on the oil uptake fried at 170,180 and 190°C and blanched at 70°C.

3.1.1.4 Effect of frying time on the oil uptake fried at 170°C and blanched at 80°C.

The potato chips were pretreated with hot water blanching at a temperature of 80°C for 5 minutes. Potato chips were fried at 170°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.64 gm fried for 30 seconds, 1.61 gm fried for 60 seconds and 1.57 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 32.8 gm/100 gm (i.e. 38.2 %), 32.2gm/100gm (i.e. 32.2 %) and 31.4 gm/100 gm (i.e. 31.4 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 32.80 gm to 31.40 gm per 100 gm. The graphical representation (fig.3.1.2) shows a linear relationship ($R^2=0.993$) for the samples blanched at 80°C for 5 minutes and fried at temperatures of 170°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.4

$$Y = -0.035X + 1.676 \quad \text{- Eqn. (3.1.1.4)}$$

3.1.1.5 Effect of frying time on the oil uptake fried at 180°C and blanched at 80°C.

The potato chips were pretreated with hot water blanching at a temperature of 80°C for 5 minutes. Potato chips were fried at 180°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.53 gm fried for 30 seconds, 1.49 gm fried for 60 seconds and 1.44 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 30.60 gm/100 gm (i.e. 30.6 %), 29.80 gm/100gm (i.e. 29.8 %) and 28.80 gm/100 gm (i.e. 28.8 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 30.60 gm to 28.80 gm per 100 gm. The graphical representation (fig.3.1.2) shows a linear relationship ($R^2=0.995$) for the samples blanched at 80°C for 5 minutes and fried at temperatures of 180°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.5

$$Y = -0.045X + 1.576 \quad \text{- Eqn. (3.1.1.5)}$$

3.1.1.6 Effect of frying time on the oil uptake fried at 190°C and blanched at 80°C

The potato chips were pretreated with hot water blanching at a temperature of 80°C for 5 minutes. Potato chips were fried at 190°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. 190°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.40 gm fried for 30 seconds, 1.36 gm fried for 60 seconds and 1.32 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 28.00 gm/100 gm (i.e. 28 %), 27.20 gm/100gm (i.e. 27.2 %) and 26.40 gm/100 gm (i.e. 26.4 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 28.00 gm to 26.40 gm per 100 gm. The graphical representation (fig.3.1.2) shows a linear relationship ($R^2=1$) for the samples blanched at 80°C for 5 minutes and fried at temperatures of 190°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.6

$$Y = -0.04X + 1.44 \quad \text{- Eqn. (3.1.1.6)}$$

The graphical representation for the samples blanched at 80°C and oil uptake is shown in figure 3.1.2

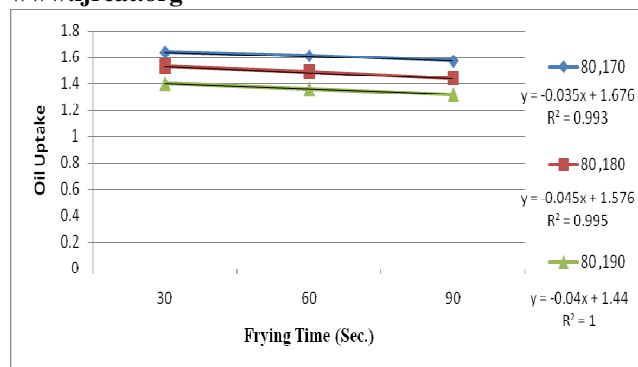


Fig-3.1.2 Effect of frying time on the oil uptake fried at 170,180 and 190°C and blanched at 80°C.

3.1.1.7 Effect of frying time on the oil uptake fried at 170°C and blanched at 90°C

The potato chips were pretreated with hot water blanching at a temperature of 90°C for 5 minutes. Potato chips were fried at 170°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.25 gm fried for 30 seconds, 1.23 gm fried for 60 seconds and 1.21 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 25.0 gm/100 gm (i.e. 25 %), 24.6 gm/100gm (i.e. 24.6 %) and 24.2 gm/100 gm (i.e. 24.2 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 25.00 gm to 24.20 gm per 100 gm. The graphical representation (fig.3.1.3) shows a linear relationship ($R^2=1$) for the samples blanched at 90°C for 5 minutes and fried at temperatures of 170°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.7

$$Y = -0.02X + 1.27 \quad \text{--- Eqn. (3.1.1.7)}$$

3.1.1.8 Effect of frying time on the oil uptake fried at 180°C and blanched at 90°C

The potato chips were pretreated with hot water blanching at a temperature of 90°C for 5 minutes. Potato chips were fried at 180°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 1.18 gm fried for 30 seconds, 1.15 gm fried for 60 seconds and 1.12 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 23.60 gm/100 gm (i.e. 23.6 %), 23.00 gm/100gm (i.e. 23.0 %) and 22.40 gm/100 gm (i.e. 22.4 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 23.60 gm to 22.40 gm per 100 gm.

The graphical representation (fig.3.1.3) shows a linear relationship ($R^2=1$) for the samples blanched at 90°C for 5 minutes and fried at temperatures of 180°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.8

$$Y = -0.03X + 1.21 \quad \text{--- Eqn. (3.1.1.8)}$$

3.1.1.9 Effect of frying time on the oil uptake fried at 190°C and blanched at 90°C

The potato chips were pretreated with hot water blanching at a temperature of 90°C for 5 minutes. Potato chips were fried at 190°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. . And fat content was found 1.10 gm fried for 30 seconds, 1.07 gm fried for 60 seconds and 1.03 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 22.00 gm/100 gm (i.e. 22 %), 21.40 gm/100gm (i.e. 21.40 %) and 20.60 gm/100 gm (i.e. 20.6 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time. The oil uptake reduced from 22.00 gm to 20.60 gm per 100 gm. However **Blumenthal, (1991) and Bouchon & Pyle, (2003)** stated that the higher oil uptake during frying caused by the longer frying time, weaker opposite water flows or by the development of different crust structures. On the other hand **Krokida et al., (2000)** determined that oil content decreased for increasing frying times, especially for the thinner products. The decrease in oil uptake with increase in frying time may be due to blanching effect. **Califano & Calvelo, (1987)** observed that the blanching step previous to frying in potato chip production improves the color and texture, and could reduce in some cases the oil uptake by gelatinization of the surface starch. The graphical representation (fig.3.1.3) shows a linear relationship ($R^2=0.993$) for the samples blanched at 90°C for 5 minutes and fried at temperatures of 180°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.9

$$Y = -0.035X + 1.136 \quad \text{.... Eqn. (3.1.1.9)}$$

The graphical representation for the samples blanched at 90°C and oil uptake is shown in figure 3.1.3

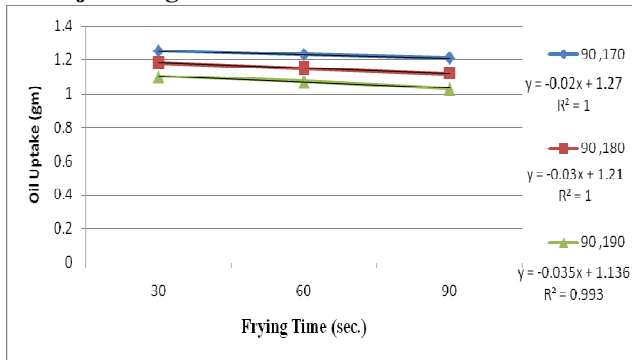


Fig.-3.1.3 Effect of frying time on the oil uptake fried at 170,180 and 190°C and blanched at 90°C.

3.1.1.10 Effect of frying time on the oil uptake fried at 170°C and unblanched (control) sample

The potato chips were not blanched and Potato chips were fried at 170°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 2.23 gm fried for 30 seconds, 2.31 gm fried for 60 seconds and 2.29 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 46.4 gm/100 gm (i.e. 46.4 %), 46.2 gm/100gm (i.e. 46.2 %) and 45.81 gm/100 gm (i.e. 45.81 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time.

The graphical representation (fig.3.1.4) shows a linear relationship ($R^2=0.0964$) for the samples fried at temperatures of 170°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.10

$$Y = - 0.015X + 2.336 \quad \text{--- Eqn. (3.1.1.10)}$$

3.1.1.11 Effect of frying time on the oil uptake fried at 180°C and unblanched (control) sample

The potato chips were not blanched and Potato chips were fried at 180°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 2.27 gm fried for 30 seconds, 2.24 gm fried for 60 seconds and 2.21 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 45.4 gm/100 gm (i.e. 45.4 %), 44.8 gm/100gm (i.e. 44.8 %) and 44.2 gm/100 gm (i.e. 44.2 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time.

The graphical representation (fig.3.1.4) shows a linear relationship ($R^2=1$) for the samples fried at temperatures of 170°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.11

$$Y = - 0.03X + 2.3 \quad \text{.... Eqn. (3.1.11)}$$

3.1.1.12 Effect of frying time on the oil uptake fried at 190°C and unblanched (control) sample

The potato chips were not blanched and Potato chips were fried at 190°C for three different time periods i.e. for 30 seconds, 60 seconds and for 90 seconds. And fat content was found 2.19 gm fried for 30 seconds, 2.16 gm fried for 60 seconds and 2.13 gm fried for 90 seconds as the sample for analyzing the fat was taken 5 gm.

The fat content was found 43.8 gm/100 gm (i.e. 43.8 %), 43.2 gm/100gm (i.e. 43.2 %) and 42.6 gm/100 gm (i.e. 42.6 %) fried at a time 30 seconds, 60 seconds and 90 seconds respectively. A critical observation shows that the oil uptake decreases due to the increase in frying time.

The graphical representation (fig.3.1.4) shows a linear relationship ($R^2=1$) for the samples fried at temperatures of 170°C for 30, 60 and 90 seconds. The linear regression equation has been given in equation no. 3.1.1.12

$$Y = - 0.03X + 2.22 \quad \text{.... Eqn. (3.1.1.12)}$$

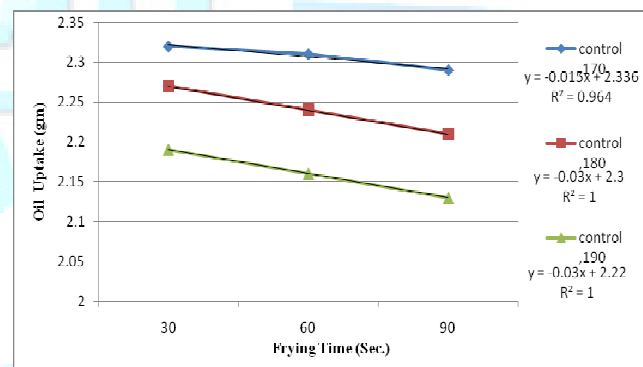


Fig- 3.1.4 Effect of frying time on the oil uptake fried at 170,180 and 190°C and unblanched

3.2.1 Effect of frying temperature on oil uptake of potato chips

3.2.1.1 Effect of frying temperature on the oil uptake fried for 30 seconds and blanched at 70°C.

The potato chips were pretreated with hot water blanching at a temperature of 70°C for 5 minutes. Potato chips were fried for 30 sec. at three different temperature i.e. for 170, 180 and for 190°C. And fat content was found 2.01 gm fried at 170°C, 1.93 gm fried at 180°C and 1.85 gm fried at 190°C as the sample for analyzing the fat was taken 5 gm.

The fat content was found 40.2 gm/100 gm (i.e. 40.2 %), 38.6 gm/100gm (i.e. 38.6 %) and 37.0 gm/100 gm (i.e. 37 %) fried at a temperature of 170, 180 and 190°C respectively. A critical observation shows that the oil

uptake decreases due to the increase in frying temperature in the present study.

But **Garayo and Moreira, (2002)** observed higher fat content at higher frying temperature for potato chips. **Alvarez et al., (2000), Krokida et al., (2001)** also reported an increase in oil content with an increasing temperature of the frying oil. On the other hand **Guillaumin (1988)** stated that there was no impact of the oil uptake for frying temperatures in the range of 150-180°C. The increase in oil uptake with higher frying oil temperatures can be attributed to increase in porosity due to higher temperatures.

The graphical representation (fig.3.2.1) shows a linear relationship ($R^2=1$) for the samples blanched at 70°C for 5 minutes and fried for 30 seconds at 170, 180 and 190°C. The linear regression equation has been given in equation no. 3.2.1.1

$$Y = -0.08X + 2.09 \quad \dots \text{Eqn. (3.2.1.1)}$$

3.2.1.2 Effect of frying temperature on the oil uptake fried for 60 seconds and blanched at 70°C.

The potato chips were pretreated with hot water blanching at a temperature of 70°C for 5 minutes. Potato chips were fried for 60 sec. at three different temperature i.e. for 170, 180 and for 190°C. And fat content was found 1.98 gm fried at 170°C, 1.91 gm fried at 180°C and 1.83 gm fried at 190°C as the sample for analyzing the fat was taken 5 gm. The fat content was found 39.6 gm/100 gm (i.e. 39.6 %), 38.2 gm/100gm (i.e. 38.2 %) and 36.6 gm/100 gm (i.e. 36.6 %) fried at a temperature of 170, 180 and 190°C respectively.

A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 39.60 gm to 36.60 gm per 100 gm. The graphical representation (fig.3.2.1) shows a linear relationship ($R^2=0.998$) for the samples blanched at 70°C for 5 minutes and fried for 60 seconds at 170, 180 and 190°C. The linear regression equation has been given in equation no. 3.2.1.2

$$Y = -0.075X + 2.056 \quad \dots \text{Eqn. (3.2.1.2)}$$

3.2.1.3 Effect of frying temperature on the oil uptake fried for 90 seconds and blanched at 70°C.

The potato chips were pretreated with hot water blanching at a temperature of 70°C for 5 minutes. Potato chips were fried for 90 sec. at three different temperature i.e. for 170, 180 and for 190°C. And fat content was found 1.96 gm fried at 170°C, 1.88 gm fried at 180°C and 1.81 gm fried at 190°C as the sample for analyzing the fat was taken 5 gm. The fat content was found 39.2 gm/100 gm (i.e. 39.2 %), 37.6 gm/100gm (i.e. 37.6 %) and 36.2 gm/100 gm (i.e. 36.2 %) fried at a temperature of 170, 180 and 190°C

respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 39.20 gm to 36.20 gm per 100 gm. The graphical representation (fig.3.2.1) shows a linear relationship ($R^2=0.998$) for the samples blanched at 70°C for 5 minutes and fried for 60 seconds at 170, 180 and 190°C. The linear regression equation has been given in equation no. 3.2.1.3

$$Y = -0.998X + 2.033 \quad \dots \text{Eqn. (3.2.1.3)}$$

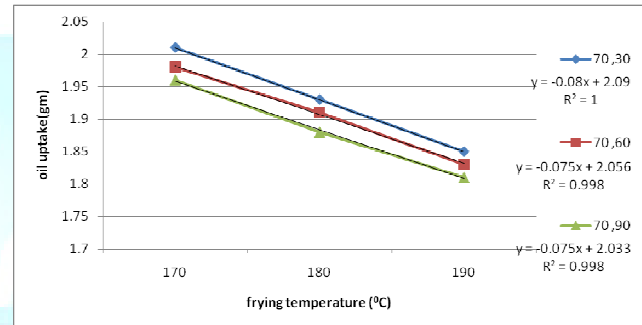


Fig-3.2.1 Effect of frying temperature on the oil uptake fried for 30, 60 and 90 seconds and blanched at 70°C.

3.2.1.4 Effect of frying temperature on the oil uptake fried for 30 seconds and blanched at 80°C.

The potato chips were pretreated with hot water blanching at a temperature of 80°C for 5 minutes. Potato chips were fried for 30 sec. at three different temperature i.e. for 170, 180 and for 190°C. And fat content was found 1.64 gm fried at 170°C, 1.53 gm fried at 180°C and 1.40 gm fried at 190°C as the sample for analyzing the fat was taken 5 gm. The fat content was found 32.8 gm/100 gm (i.e. 32.8 %), 30.6 gm/100gm (i.e. 30.6 %) and 28.0 gm/100 gm (i.e. 28 %) fried at a temperature of 170, 180 and 190°C respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 32.80 gm to 28.00 gm per 100 gm. The graphical representation (fig.3.2.2) shows a linear relationship ($R^2=0.997$) for the samples blanched at 80°C for 5 minutes and fried for 30 seconds at 170, 180 and 190°C. The linear regression equation has been given in equation no. 3.2.1.4

$$Y = -0.12X + 1.763 \quad \dots \text{Eqn. (3.2.1.4)}$$

3.2.1.5 Effect of frying temperature on the oil uptake fried for 60 seconds and blanched at 80°C.

The potato chips were pretreated with hot water blanching at a temperature of 80°C for 5 minutes. Potato chips were fried for 60 sec. at three different temperature i.e. for 170, 180 and for 190°C. And fat content was found 1.61 gm

fried at 170^oc, 1.49 gm fried at 180^oc and 1.36 gm fried at 190^oc as the sample for analyzing the fat was taken 5 gm. The fat content was found 32.2 gm/100 gm (i.e. 32.2 %), 29.8 gm/100gm (i.e. 29.8 %) and 27.2 gm/100 gm (i.e. 27.2 %) fried at a temperature of 170, 180 and 190^oc respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 32.20 gm to 27.20 gm per 100 gm. The graphical representation (fig.3.2.2) shows a linear relationship ($R^2=0.999$) for the samples blanched at 80°C for 5 minutes and fried for 60 seconds at 170, 180 and 190^oc. The linear regression equation has been given in equation no. 3.2.1.5

$$Y = -0.125X + 1.763 \quad \text{- Eqn. (3.2.1.5)}$$

3.2.1.6 Effect of frying temperature on the oil uptake fried for 90 seconds and blanched at 80^oc.

The potato chips were pretreated with hot water blanching at a temperature of 80^oc for 5 minutes. Potato chips were fried for 90 sec. at three different temperature i.e. for 170, 180 and for 190^oc. And fat content was found 1.57 gm fried at 170^oc, 1.44 gm fried at 180^oc and 1.32 gm fried at 190^oc as the sample for analyzing the fat was taken 5 gm.

The fat content was found 31.4 gm/100 gm (i.e. 31.4 %), 28.8 gm/100gm (i.e. 28.8 %) and 26.4 gm/100 gm (i.e. 26.4 %) fried at a temperature of 170, 180 and 190^oc respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 31.40 gm to 26.40 gm per 100 gm. The graphical representation (fig.3.2.2) shows a linear relationship ($R^2=0.999$) for the samples blanched at 80°C for 5 minutes and fried for 90 seconds at 170, 180 and 190^oc. The linear regression equation has been given in equation no. 3.2.2.6

$$Y = -0.125X + 1.693 \quad \text{- Eqn. (3.2.2.6)}$$

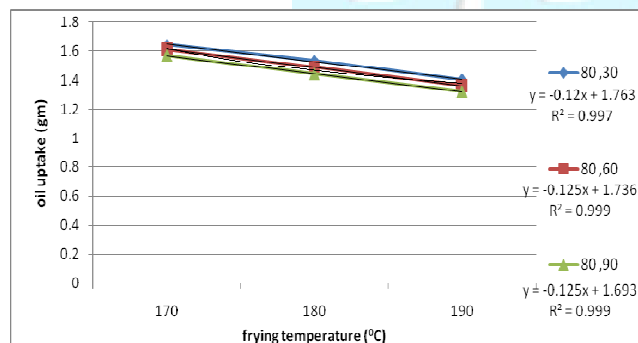


Fig-3.2.2 Effect of frying temperature on the oil uptake fried for 30, 60 and 90 seconds and blanched at 70^oc.

3.2.1.7 Effect of frying temperature on the oil uptake fried for 30 seconds and blanched at 90^oc.

The potato chips were pretreated with hot water blanching at a temperature of 90^oc for 5 minutes. Potato chips were fried for 30 sec. at three different temperature i.e. for 170, 180 and for 190^oc. And fat content was found 1.25 gm fried at 170^oc, 1.18 gm fried at 180^oc and 1.10 gm fried at 190^oc as the sample for analyzing the fat was taken 5 gm. The fat content was found 25.00 gm/100 gm (i.e. 25.0 %), 23.60 gm/100gm (i.e. 23.6 %) and 22.0 gm/100 gm (i.e. 22 %) fried at a temperature of 170, 180 and 190^oc respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 25.00 gm to 22.00 gm per 100 gm. The graphical representation (fig.3.2.3) shows a linear relationship ($R^2=0.998$) for the samples blanched at 90°C for 5 minutes and fried for 30 seconds at 170, 180 and 190^oc. The linear regression equation has been given in equation no. 3.2.1.7

$$Y = -0.075X + 1.326 \quad \text{- Eqn. (3.2.1.7)}$$

3.2.1.8 Effect of frying temperature on the oil uptake fried for 60 seconds and blanched at 90^oc.

The potato chips were pretreated with hot water blanching at a temperature of 90^oc for 5 minutes. Potato chips were fried for 60 sec. at three different temperature i.e. for 170, 180 and for 190^oc. And fat content was found 1.23 gm fried at 170^oc, 1.15 gm fried at 180^oc and 1.07 gm fried at 190^oc as the sample for analyzing the fat was taken 5 gm.

The fat content was found 24.6 gm/100 gm (i.e. 24.6 %), 23.0 gm/100gm (i.e. 23 %) and 21.40 gm/100 gm (i.e. 21.40 %) fried at a temperature of 170, 180 and 190^oc respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 24.60 gm to 21.40 gm per 100 gm.

The graphical representation (fig.3.2.3) shows a linear relationship ($R^2=1$) for the samples blanched at 90°C for 5 minutes and fried for 60 seconds at 170, 180 and 190^oc. The linear regression equation has been given in equation no. 3.2.1.8

$$Y = -0.08X + 1.31 \quad \text{- Eqn. (3.2.1.8)}$$

3.2.1.9 Effect of frying temperature on the oil uptake fried for 90 seconds and blanched at 90^oc.

The potato chips were pretreated with hot water blanching at a temperature of 90^oc for 5 minutes. Potato chips were fried for 90 sec. at three different temperature i.e. for 170, 180 and for 190^oc. And fat content was found 1.21 gm fried at 170^oc, 1.12 gm fried at 180^oc and 1.03 gm fried at 190^oc as the sample for analyzing the fat was taken 5 gm.

The fat content was found 24.2 gm/100 gm (i.e. 24.2 %), 22.4 gm/100gm (i.e. 22.4 %) and 20.6 gm/100 gm (i.e.

20.6 %) fried at a temperature of 170, 180 and 190⁰c respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 24.60 gm to 21.40 gm per 100 gm. The reduction in oil content with increasing frying temperature is due to blanching and pre-drying of potato chips. The decrease in the oil uptake with higher blanching temperatures can be attributed to a more rigid and compact structure with low porosity and effective water diffusivity than unblanched samples, **Ji Mate et al., (1998)**. Blanching reduced the permeability of the surface layer to water vapour due to gelatinization of the starch on the surface. **Moreira, (1999)** also stated that blanching forms a layer of gelatinized starch that limits oil absorption and improves the texture. Drying of potatoes before frying using microwave, hot-air treatment and baking has resulted in a significant reduction in oil content of different products (**Krokida, Oreopolou, Maroulis, & Marinou-Kouris 2001, Moyano, Róseco, & González 2002**). The reduction in oil uptake in blanched potato chips more in comparison with unblanched potato chips and it ranges from 46.40 gm to 20.60 gm. The graphical representation (fig.3.2.3) shows a linear relationship ($R^2=1$) for the samples blanched at 90⁰c for 5 minutes and fried for 90 seconds at 170, 180 and 190⁰c. The linear regression equation has been given in equation no. 3.2.1.9

$$Y = -0.09X + 1.30 \quad \text{--- Eqn. (3.2.1.9)}$$

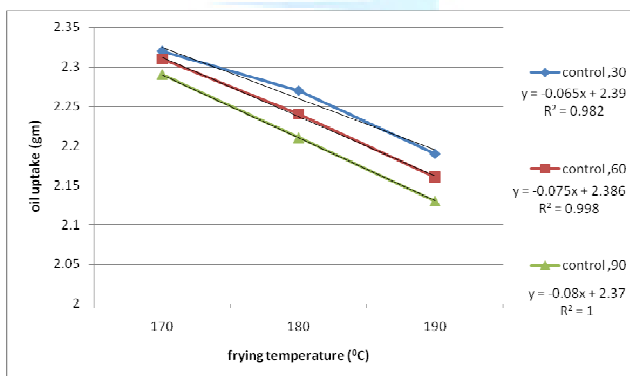


Fig-3.2.3 Effect of frying temperature on the oil uptake fried for 30, 60, 90 seconds blanched at 90⁰c.

3.2.1.10 Effect of frying temperature on the oil uptake fried for 30 sec. and unblanched (control) sample

The potato chips samples were not blanched. Potato chips were fried for 30 sec. at three different temperature i.e. for 170, 180 and for 190⁰c. And fat content was found 2.32 gm fried at 170⁰c, 2.27 gm fried at 180⁰c and 2.19 gm fried at 190⁰c as the sample for analyzing the fat was taken 5 gm.

The fat content was found 46.4 gm/100 gm (i.e. 46.4 %), 45.4 gm/100gm (i.e. 45.4 %) and 43.8 gm/100 gm (i.e. 43.8 %) fried at a temperature of 170, 180 and 190⁰c respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 46.40 gm to 45.40 gm per 100 gm. The graphical representation (fig.3.2.4) shows a linear relationship ($R^2=0.982$) for the samples fried for 30 seconds at 170, 180 and 190⁰c. The linear regression equation has been given in equation no. 3.2.1.10

$$Y = -0.065X + 2.39 \quad \text{--- Eqn. (3.2.1.10)}$$

3.2.1.11 Effect of frying temperature on the oil uptake fried for 60 sec. and unblanched (control) sample

The potato chips samples were not blanched. Potato chips were fried for 60 sec. at three different temperature i.e. for 170, 180 and for 190⁰c. And fat content was found 2.31 gm fried at 170⁰c, 2.24 gm fried at 180⁰c and 2.16 gm fried at 190⁰c as the sample for analyzing the fat was taken 5 gm.

The fat content was found 46.2 gm/100 gm (i.e. 46.2 %), 44.8 gm/100gm (i.e. 44.8 %) and 43.2 gm/100 gm (i.e. 43.2 %) fried at a temperature of 170, 180 and 190⁰c respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 46.20 gm to 43.20 gm per 100 gm. The graphical representation (fig.3.2.4) shows a linear relationship ($R^2=0.998$) for the samples fried for 60 seconds at 170, 180 and 190⁰c. The linear regression equation has been given in equation no. 3.2.1.11

$$Y = -0.075X + 2.368 \quad \text{--- Eqn. (3.2.1.11)}$$

3.2.1.12 Effect of frying temperature on the oil uptake fried for 90 sec. and unblanched (control) sample

The potato chips samples were not blanched. Potato chips were fried for 90 sec. at three different temperature i.e. for 170, 180 and for 190⁰c. And fat content was found 2.29 gm fried at 170⁰c, 2.21 gm fried at 180⁰c and 2.13 gm fried at 190⁰c as the sample for analyzing the fat was taken 5 gm.

The fat content was found 45.81 gm/100 gm (i.e. 45.81 %), 44.2 gm/100gm (i.e. 44.2 %) and 42.6 gm/100 gm (i.e. 42.26 %) fried at a temperature of 170, 180 and 190⁰c respectively. A critical observation shows that the oil uptake decreases due to the increase in frying temperature. The oil uptake reduced from 45.81 gm to 42.60 gm per 100 gm. **Moyano and Pedreschi (2006)** and **A. Kita et al (2005)** also found that the oil uptake in potato chips decreases with increase in frying temperature. The graphical representation (fig.3.2.4) shows a linear

relationship ($R^2=1$) for the samples fried for 60 seconds at 170, 180 and 190°C. The linear regression equation has been given in equation no. 3.2.1.12

$$Y = -0.08X + 2.37 \quad \dots \text{Eqn. (4.1.24)}$$

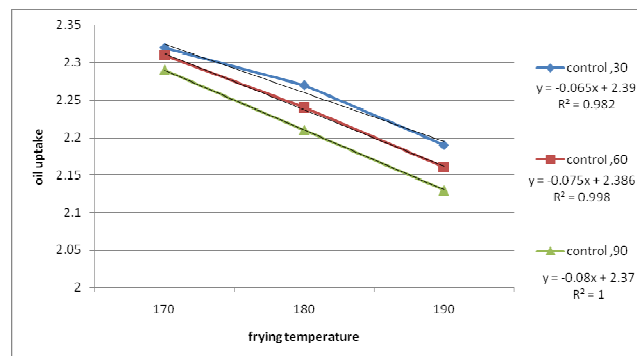


Fig-3.2.4 Effect of frying temperature on the oil uptake fried for 30, 60, 90 seconds and unblanched

4. Conclusion

The result obtained from present study shows that the oil uptake of potato chips was affected by the frying conditions i.e. frying time and frying temperature and blanching temperature. The potato chips were pretreated with hot water blanching at three levels of blanching i.e. 70, 80 and 90°C for the study and fried at three levels of frying time i.e. 30, 60 and 90 seconds and three levels of frying temperature i.e. 170, 180 and 190°C. And unblanched samples were taken as control samples. An increase in frying time from 30 to 90 seconds and frying temperature from 170 to 190°C with increase in blanching temperature from 70 to 90°C the oil uptake reduced from 46.4% to 20.6% for unblanched and blanched samples i.e. there was a total 25.8% reduction in oil uptake with increasing frying time and temperature and blanching temperature. And unblanched potato chips samples also showed a decrease in oil uptake with increase in frying time and frying temperature but the oil uptake in unblanched chips was less than blanched potato chips.

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