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Shokhan H. Hamarashid*

Food Science and quality control dept. / College of Agriculture Engineering Science/ University of Sulaimani

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Effects of Pre- Frying Treatment on Decreasing Oil Absorption During Deep Fat Frying Process

ABSTRACT

The aim of this research was to investigate the effect of pre-frying treatments; there are blanching in water, calcium chloride solution (Cacl2), citric acid solution ($C_6H_8O_7$), and table salt/ sodium chloride solution. Then, immersion in starch solution 1% as hydrocolloid on the oil absorption and moisture content in fried potato strips. The results obtained have shown that the pre-frying treatment frequently reduced the oil absorption and increases the moisture content. The lowest oil absorption was found for the potato blanched in calcium chloride solution, and the greatest for the potato blanched in water. Additionally, immersion in hydrocolloid solution affected the fried potato oil uptake.

The best result was obtained for the potato strips blanched in 0.5% calcium chloride solution following immersion in 1% starch solution. Where the oil content reached 15% compared the potato strips blanched in water 20%. On the other hand, the potato strips was blanched by using calcium chloride 0.5%. Then, immersion in starch solution by 1% that was the highest moister content compared to other samples which was 65%.

1. INTRODUCTION

Fried foods are common food around all world and cover a wide variety of products (Zolfaghari, et al. 2001). Thus, many studies has been done to control or minimize oil content on the final fried products and improving the frying process (Garcia- Segovia, et al.2016). While the major issue in our society is demanding healthier food products with high quality from consumer but fried foods still remain popular although it has a linking with a health problems for example obesity, hypertension, coronary heart disease and etc. One of the popular cooking method is frying that is used in most of countries. Changing in taste and flavour happened caused by frying, which is a main reason to increase food palatability for consumer (Kang and Kim, 2016).

In an institutional preparation of foods, deep fat frying is used widely because the consumers prefer the properties of fried food products. However, the fried foods include significant amount of fat. For instance, in potato chips rate of oil in the total food product by weight is 1/3 (Kim, et al. 2011). In that process, movement happens between the oil and water content in the products. There is strictly linked between oil absorption and moisture loss. To meet consumer demand, both of health and sensory aspects should be addressed in fried products.

Recently, most people has recognized the desirability of reducing fat content of deep fried products. Therefore, consumer trends are moving toward healthier foods and low fat products, creating the need to develop technologies to reduce the amount of oil in the end fried products (Amboon, et al. 2012).

* *Corresponding author: E-mail*: shokhan.hamarashid@univsul.edu.iq

Now a day, many investigations carrying out to deceasing oil absorption during frying process and remain same flavor and texture (Garcia- Segovia, et al.2016). There are several factors which are affected on the degree of oil absorption. For example, temperature and time as process conditions, dipping in sugar or salt solutions as food product pretreatment, physico-chemical characteristics of food, chemical composition of oil and others (Moyano and Pedreschi, 2006).

Potato is a main and major agricultural crops around a whole world. Millions of people who have a different cultural backgrounds consumed potato every day. Potatoes are cultivated in approximately 80% of all countries and worldwide production stands in excess of 300 million tons per year (Chiou,et al. 2012). Potato contain main nutrient that is important to daily supply such as carbohydrates, protein, vitamins and minerals. French fries/ finger chips is one of the most popular processed potato. Finger chips are among the major commercial fried foods that other types of processed potatoes (Troncoso and Pedreschi , 2009).

2. MATERIALS AND METHOD

2.1. Materials

Starch as hydrocolloid, Calcium chloride, Citric acid, Sunflower oil, Table salt, Hexane, Potato and tap water were used throughout the work. Furthermore, all materials were bought from local market in Sulaimanyah, except the Calcium chloride was donated by the Soil and Water Sciences department on College of Agricultural Engineering Science. Salt/Sodium Chloride was containing grounding preventer material (potassium ferro siyanid E536 and potassium iodate). Hexane was used as the main solvent in the Soxhlet extraction to extraction the oil.

2.2. Potato preparation

Manually, the potato was washed, peeled and cut. It was cut into regular strips that around into 8 X 8 length X 60 width mm. The strips were divided into four portions or parts.

2.3. Blanching process

In food processing, blanching is a one of a step to preparation food that food product immersed in hot water or steam (Garcia- Segovia, et al.2016). In this research it was done before frying like pre-treatment for sample.

The first potato part was blanched just in water at 85 C˚ for 6 minutes, the second potato part, third and fourth part were blanched in 0.5% aqueous solution of calcium chloride, 1% citric acid, 1% salt solution respectively, at the same conditions it means temperature and time. After blanching process, the all potato samples without the first portion, immersed in 1% starch solution as hydrocolloid during two minutes at room ttemperature. After that, the strips were drained and take on convection oven at 150°C for 3 minutes to dried and reduce the surface water (Jafarin and Mohammadnejad, 2020).

2.4. Frying process

Vegetable oil used to deep fat frying potato strips and rate of potato strips/ volume of oil is 1:6 (Rima-Brncic , et al., 2004). Therefore, removing oil along with the fried potatoes happen. The level of oil should be checked and replenished after each frying batch. All fried samples were left at room temperature to cooling then prepared for analysis moisture and oil content.

2.5. Moisture content analysis

Determining moisture content was obtained by drying samples until reached constant weight in an oven at 105°C (AOAC, 2004). Then, weighed the samples several times until got a constant weight. This experiment was run in triplicate and the present results are the average of the obtained results. The moisture content was found by using the following equation:

$$\text{Moisture } (\%) = \frac{Initial\ weight\ of\ sample - final\ weight\ of\ sample}{Initial\ weight\ of\ sample} X100$$

2.6. Analysis oil Content

In present work, Soxhlet extraction used to determine oil content (Rima-Brncic , et al., 2004 and Salvador et al., 2005). This measurement was done in duplicate. After reaching a 68°C, which is the boiling point temperature of Hexane. Hexane starts boiling. Then, it needs evaporated the Hexane to get the extracted oil. This extraction technique takes a long time, for instant, to extracted oil without evaporated the solvent needs around 3 hours. After the solvent evaporating, weight extracted oil and then calculated by using the following equation:

$$\text{Oil content (\%)} = \frac{weight\ of\ extracted\ oil}{weight\ of\ sample} X100$$

3. RESULTS AND DISCUSSION

3.1 Pre-frying treatment effects on moisture content

The effect of pre- frying treatment, hydrocolloid for fried potato of moisture content was found and it is shown in figure 1. The moisture content in potato strips blanched in Calcium chloride had the highest value that was 65.1%, followed that control which was blanched in water, potato strips blanched in citric acid, potato strips blanched in salt (Sodium chloride) was 58.7%, 60.5% and 62.6% respectively. After blanching, moisture content increased in potato strips because of in the blanching medium, migration of soluble compounds from the potato happened (Rima-Brncic , et al., 2004). In fried potato strips, potato solids increase and water content decrease caused by frying process. The highest value of moisture content was noticed in potato samples pre- treatment with calcium chloride and starch solution.

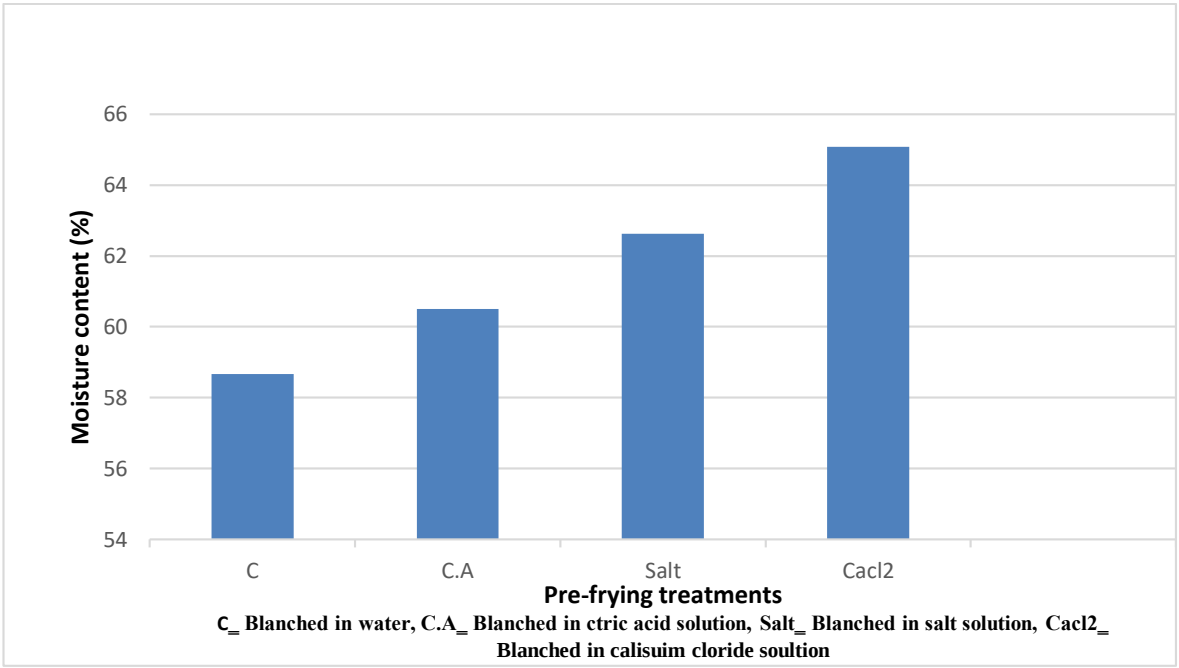

Figure1. Effects pre-frying treatment on moisture content of deep fat fired potato strips.

Reported by Pinthus et al. (1995) that oil contents decreased with increasing moisture content. Higher oil uptake ratio caused by lower moisture content (figure1 and figure2). In addition, Wuestenberg (2015) showed, during deep fat frying process oil absorption positively correlated with moisture content. For thickening many foods the Hydrocolloids is used frequently (Wuestenberg, 2015). Type and concentration of hydrocolloid that had be used and type, pH and temperature of food system are factors depending to the thickening effect. The most hydrocolloid thickener is starch that is very popular (Dipjyoti Saha and Suvendu Bhattacharya, 2010), Because of the price of starch is cheap and it hasn't undesirable taste and strange taste when it is used in food products.

3.2 Effect of pre-frying treatment on oil absorption

After removing the samples from the fryer and cooling them, oil content was determined in this work. Depend on the data (Figure 2), potato samples treated with citric acid solution slightly reduced oil content compared to the potato samples treated with calcium chloride solution. The results show that calcium chloride has ability to stabilize the tissue structure against the violence of the frying process. Rima-Brncic, et al., (2004) reported, that can be explained by reaction between calcium and native pectin of the potato tissue. Pectic substances are part of the intercellular material in most of fruit and vegetable including potato. The Presence of that effect on those texture. Pectic enzymes can creating more rigid structures by producing free carboxylic groups. Therefore, carboxylic group can react with divalent ions such as calcium.

Depend on the results, immersion the potato strips in 1% hydrocolloid effective in oil uptake. Starch as hydrocolloid were effect on reducing oil content (figure2). So, the potato strips treated with calcium chloride had the highest effect by 15%. Therefore, calcium chloride help to decrease oil uptake in fried food (Fellows, P.j. 2017), followed potato strips balanced in citric acid was exhibited the lowest effect which was 18%. The sample blanching in water and without hydrocolloid had the highest oil content which was 20%. It was found by Pinthus, et al. (1995), pre- frying treatment by hydrocolloid may alter the water-holding capacity and consequently influence on oil absorption. Treated with calcium chloride and starch solution is the best procedure for obtained the lowest oil absorption during deep fat frying process (figure2). On the other hand, hydrocolloids and calcium chloride have ability to forming a fine net structure as gel-forming compounds and cross linking agent. During frying process, can prevent water migration in the potato tissue by that net structure (Pinthus, et al. 1995).

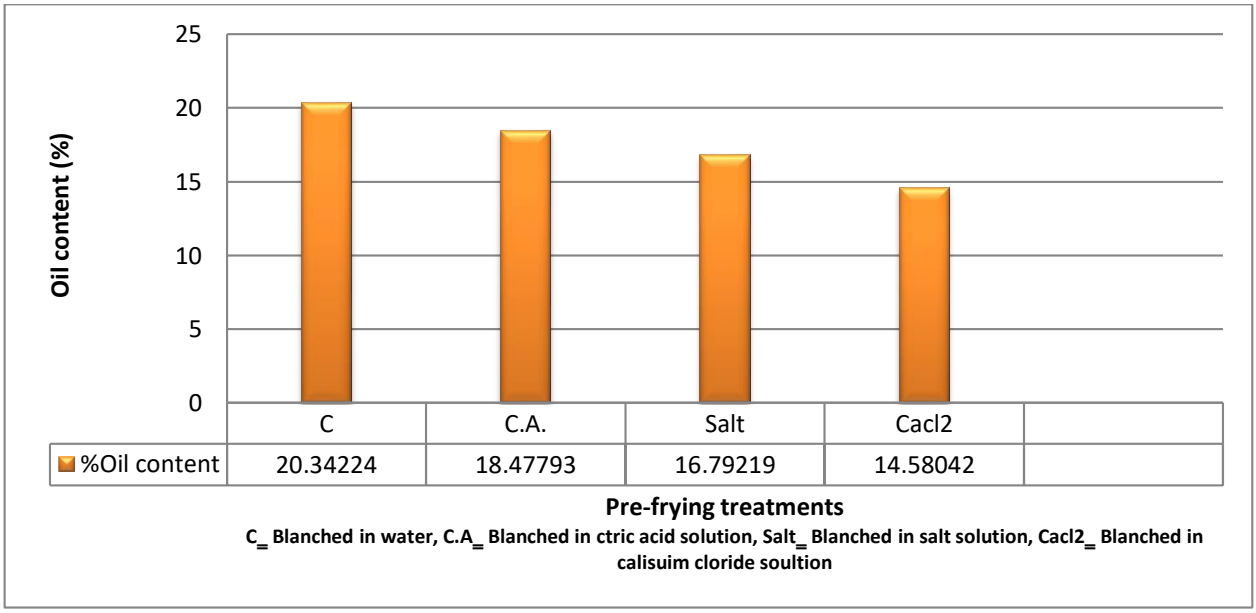

Figure2. Effects pre-frying treatment on oil content of deep fat fired potato strips.

Depend on the result, it can be say that pre-frying treatment for potato strips causes raise resistance to oil absorption reducing oil uptake. Increasing the moisture content of potato strips by pre-frying treatment is the one of efficient way to reduce oil uptake in the final fried product (Bingol, et al. 2012). One example for pre-treatment is blanching that could be decrease oil absorption of fried potato chips and improve the overall properties such as color and texture (Moyano and Pedreschi, 2006).

In fried product, lower fat content with higher moisture contents have association together. In frying process, when moisture is removed from the food oil absorption occurs (Pinthus, et al. 1995). The oil content in control sample, potato stripes blanched in citric acid, potato stripes blanched in table salt and potato stripes blanched in calcium chloride were 20.3%, 18.5%, 16.8% and 14.6% respectively.

4. CONCLUSION

Blanching in some solutions as pre-frying treatment in combination with immersion in starch solution as hydrocolloid was affected on fried potato strips by decreasing the oil content and raised the moisture content. In this present work, Pre-frying treatment with 0.5% calcium chloride and 1% starch solutions was the best result. After that, Pre-frying treatment with table salt/sodium chloride and citric acid solution then immersion 1% starch solution as hydrocolloid decreased oil content respectively.

5. RECOMMENDATION

When, pre-frying treatments reduced the oil uptake. Therefore, more than one types of hydrocolloids for example cellulose derivate, pectin and gum etc. can be recommended to be used to pre-frying treatment for potato strips for helps more reducing oil absorption during frying process.

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آثار المعالجات قبل القلي على تقليل امتصاص الزيت خلال عملية القلي العميق بالدهون

شوخان هيدايت حمةرشيد

قسم علوم الاغذية والسيطرة النوعية/ كلية هندسة العلوم الزراعية/ جامعة السليمانية

المستخلص

الهدف من هذا البحث هو دراسة تأثيربعض معالجات ما قبل عملية القلي، والتي هي السلق في المحاليل المائية لكلوريد الكالسيوم (Cacl2)، حامض الستريك (C6H8O7) وملح الطعام (كلوريد الصوديوم NaCl). بعد ذلك، النقع في محلول نشاء ١ ٪ على شكل غرواني مائي في امتصاص الزيت ونسبة الرطوبة في البطاطس المقلية. النتائج التي تم الحصول عليها، أن معالجة ما قبل عملية القلي تقلل في كثير من الأحيان امتصاص الزيت وتزيد من نسبة الرطوبة. نسبة أدنى لامتصاص الزيت وجد في البطاطس المقلية عندما سلق في محلول كلوريد الكالسيوم (Cacl2)، ونسبة أكبر وجد في البطاطس المقلية عندما السلق في الماء .بالإضافة إلى ذلك، النقع في المحلول الغرواني المائي اثرت في امتصاص زيت البطاطس المقلية. تم الحصول على أفضل نتيجة لشرائح البطاطس المقلية عندما السلق في ٠،٥٪ من المحلول كلوريد الكالسيوم (Cacl2) والذي نقع في محلول النشا، حيث بلغ محتوى الزيت ١٥٪ مقارنة بشرائح البطاطس المقلية المسلوقة بالماء ٢٠٪. من جهة أخرى، كانت البطاطس المقلية المسلوقة في ٠،٥٪ من محلول كلوريد الكالسيوم بعد النقع في محلول النشا١٪ تحتوي على أعلى نسبة رطوبة مقارنة بالعينات الأخرى والتي كانت ٦٥٪.

الكلمات المفتاحية: المعالجات قبل القلي، البطاطا، الرطوبة، امتصاص الدهن.