The Pharma Innovation Journal 2023; 12(8): 2425-2429

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(8): 2425-2429

www.thepharmajournal.com
Received: 01-05-2023
Accepted: 05-06-2023

Awadhesh Kumar Yadav
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Suresh Chandra
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

BR Singh
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Jaivir Singh
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Neelash Chauhan
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Deepak Kumar Mishra
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Tarun Kumar
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Corresponding Author:
Awadhesh Kumar Yadav
Department of Agricultural Engineering, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, Uttar Pradesh, India

Comparative analysis of different pretreatments on oil uptake kinetics of cucumber chips

Awadhesh Kumar Yadav, Suresh Chandra, BR Singh, Jaivir Singh, Neelash Chauhan, Deepak Kumar Mishra and Tarun Kumar

Abstract
Popular snacks like cucumber chips are frequently deep-fried, which uses a lot of oil in the cooking process. In addition to affecting the sensory qualities of the chips, excessive oil uptake is unhealthy due to the increased fat content. The purpose of this study was to evaluate and compare how various pretreatments affected how quickly cucumber chips absorbed oil during frying. The T_1, T_2, T_3, T_4, and T_5 therapy approaches were chosen. Before deep-frying, cucumber chips underwent pretreatments, and their oil uptake kinetics were assessed and compared. At a constant temperature of 180 °C, the pretreatment cucumber chips were deep-fried, and the oil uptake was monitored frequently.

Keywords: Cucumber chips, oil uptake kinetics, pretreatment, deep-frying

Introduction
In many nations, cucumbers (*Cucumis sativus* L.) are one of the most widely consumed vegetables. It is a member of the cucurbitaceous family. The crop's primary ingredient (96%) is water, and it contains a lot of vitamins, minerals, and organic acids, making it a nutritious food. Cucumber chips are a popular snack consumed worldwide due to their crispy texture and refreshing taste. However, the frying process involved in their production often leads to significant oil uptake, resulting in a less healthy product. To address this issue, various pretreatment methods have been explored to minimize oil absorption during frying. By comparing the impacts of several pretreatments on the oil uptake kinetics of cucumber chips, this comparative analysis intends to assess the possibility for lowering oil absorption and enhancing the overall quality of the finished product. Cucumber contains (96.3 g) water, (0.4g) protein, (0.1 g) fat, (0.3 g) minerals, (0.4 g) fiber, (2.5 g) carbohydrate, (13Kcal) energy, (10 mg) calcium, (25 mg) phosphorus, (1.5 mg) iron, (0.33 mg) thiamine, (0.2 mg) niacin, (7 mg) vitamin "C" per (100 g) edible portion (Gopalan *et al.*, 1982) [16]. Deep-fat frying is a complicated physicochemical process that is simultaneously influenced by a variety of variables, including temperature, time, the kind of frying oil and fried food, whether the heat is constant or intermittent, the fryer model, the use of filters, and the addition of additional oil. (Chatzilazarou *et al.*, 2006; Kalogianni *et al.*, 2010; Rojo and Perkins, 1987) [13, 14, 5]. When food is fried, a range of factors such as frying time, temperature, initial moisture content of the product, oil quality, product shape, interfacial tension, post-frying treatment, and food surface condition can affect how much fat is absorbed. (Gamble *et al.*, 1989) [4]. Typically, frying entails utilising a liquid oil as a heating medium to cook food quickly at a relatively high temperature. Dana, D. and Saguy, I.S. (2006) [10]. During deep-fat frying, mass transfer causes the dissipation of oil, protein, carbohydrate, vitamin and moisture from fried food and product oil uptake (Krokida *et al.*, 2000; Sosa-Morales *et al.*, 2006) [2, 15]. Because of the high frying temperatures employed, items usually only need to be fully cooked for a short period of time (between 0.5 and 5 minutes). (Tian *et al.*, 2016) [11]. Saguy and Pinthus, (1995) [17] suggested that as the water is evaporated from the product during frying, the rate of oil absorption increases due to a reduction in the pore internal pressure. Convection, which is created by free water boiling at the surface when moist food is submerged in hot oil, is one of the two ways that heat can be transferred when oil is heated. The moisture vaporizes out, and creates a path known as capillary pore, through which hot oil enters the food. The reactions occurs by the influence of oil uptake, crust formation shrinkage and swelling, thus inducing macro-and micro structural changes (Garayo and Moreira, 2002) [1].

One of the most crucial quality criteria for fried foods is oil uptake, yet this is inconsistent with contemporary consumer trends towards healthier food and low-fat goods. (Bouchon and Pyle, 2004) [12]. Focus on the microstructure, techniques for lowering oil uptake, oil quality, bioactive compound deterioration, and hazardous compound creation (Duek and Bouchon 2011) [6]. The degradation of the oil is influenced by a variety of factors. The conditions of the process are the ones that have the biggest impact on the frying oil quality. In addition, there are additional elements including oil composition, oil absorption by food, frying time, and others. (Aladedunye *et al.*, 2014) [8].

On the quality of vacuum fried jackfruit chips, the impact of frying temperatures and times was assessed. With an increase in frying temperature and time, jackfruit chips' moisture content and breaking strength dropped. During vacuum frying, however, the oil content rose. Jackfruit chips were found to require 30, 25, and 20 minutes of cooking time at 80, 90, and 100 oC, respectively. (Maity *et al.*, 2014) [7]. The impact of pre-drying on the texture and oil uptake of potato chips was examined, and it was discovered that pre-drying considerably improved the crispness of the potato slices after frying and dramatically reduced oil absorption. (Pedreschi and Moyano 2005) [3]. Another of the best oilseed crops used to produce healthy oil is canola (Brassica napus). When compared to rapeseed oil with a high erucic acid content, this oil has different chemical, physical, and nutritional characteristics. (Beig Mohammadi *et al.*, 2012) [9].

Importance of oil uptake reduction

Excessive oil uptake during frying not only increases the caloric content of the snack but also affects its sensory attributes, self life, and overall consumer acceptance. By minimizing oil absorption, the nutritional profile of cucumber chips can be enhanced, making them a healthier snacking option.

Pretreatment Methods

The effectiveness of several pretreatment techniques in lowering oil uptake during frying is examined and contrasted in this study. The following methods are frequently used:

1. Blanching: Cucumber chips are briefly immersed in hot water or steam to soften the tissue and remove surface contaminants. Blanching can potentially reduce oil uptake by creating a barrier and modifying the surface characteristics of the chips.
2. Oil uptake kinetics: The dynamic process of oil absorption by the cucumber chips during frying is referred to as oil uptake kinetics. This investigation comprises measuring the pace and amount of oil absorption for various pretreatment techniques as well as tracking changes in oil content over time. It offers insightful data on the efficiency of pretreatments in limiting oil uptake.

Material and Method

Agricultural Engineering, College of Post Harvest Technology and Food Processing, S.V.P. University of Agriculture & Technology, Meerut (U.P.), India conducted experiments to investigate "Comparative analysis of different pretreatments on oil uptake Kinetics of Cucumber Chips" from 2020 to 2023. Experiments were carried out to evaluate physical property of chips as fresh and after frying; physic-chemical properties, frying properties cucumber chips fried in different oils were also evaluated. Various materials and methods used in the course of investigation is given under following heads.

Materials

The neighborhood market in Meerut provided the fresh vegetables. With a knife with a sharp edge, the leaves and end portion were removed. Then, the surface was washed with tap water to remove the dust and debris. Peeled and again washed with water followed by slicing with a chips cutter. The chips were then weighed and achieved sliced weight samples were made for each pretreatment and methods of drying, and then apply the different treatments.

Preparation of Cucumber Chips

The Laboratory of Agro Processing Centre, Department of Agricultural Engineering, College of Post Harvest Technology and Food Processing, S.V.P. University of Agriculture & Technology, Meerut (U.P.), India, developed the cucumber chips and conducted a comparative study on them. Studies were also carried out to evaluate physicochemical properties of oil uptake and oil uptake kinetics of cucumber chips in different oils. Cucumber chips were prepared in the following way and the flow chart

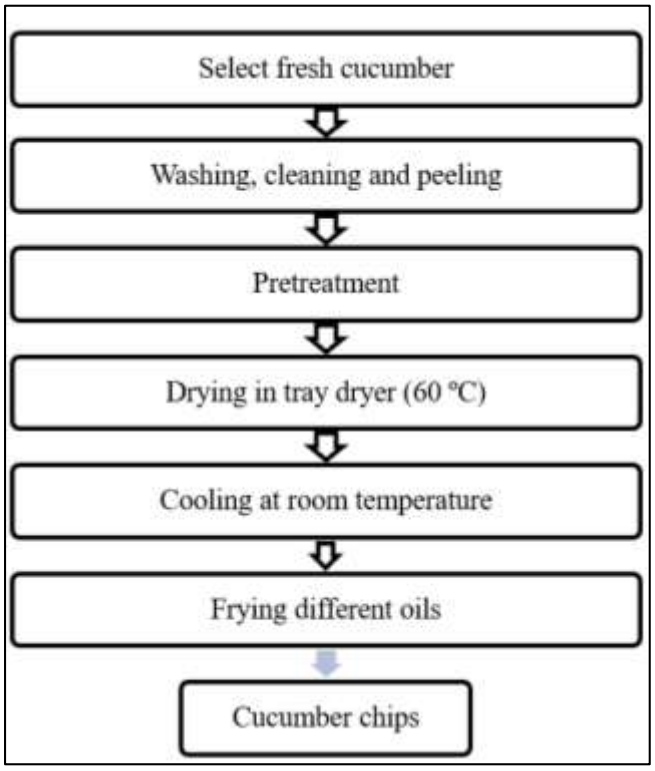

Fig 1: Flow chart for development of cucumber chips

Pretreatments

Pretreatments were applied to the cucumber slices, and an untreated sample was used as a control. The sliced was subjected to pre-treatments indicated as (1) Blanching with 90 °C for 5 min (2) Blanching with 1%Nacl at 90 °C for 5 min (3) Blanching with 0.5% KMS + 1.0% NaCl at 90 °C for 5 min. (4) Blanching with 0.5% KMS+1% NaCl + 0.5% CA at 90 °C for 5 min. (5) Blanching with 1% $Cacl_2$+1% NaCl at 90 °C for 5 min. Following their removal from the solution, the slices were spread out in trays and dried in a tray dryer at 60

°C after having the surface moisture removed by blotting paper.

Slicer
Slicer was used to make slices of vegetables. The thickness of slice was 2-3 mm and varies with slice blade.

Electronic balance
Electronic balance for sample weighing (Aczet, CY 224). A top pan electronic balance with a digital display and great precision was employed. It features a 1000 g capacity and a 0.001 g minimum count. Another electronic balance (Samson, S500) with a maximum capacity of 5 kg and a lowest count of 0.1 g was utilised for bigger product amounts. The samples were weighed using a top pan electronic balance from M/s Eagle Instruments Pvt., New Delhi, which has a minimum count of 0.002 g.

Hot air oven
The hot air oven (SANCO) has two walls and is 78 cm by 27 cm by 116 cm. While the inner chamber was made of stainless steel, the outside chamber was made of mild steel. Between two walls, 65 cm of glass wool insulation was installed. For uniform heating, heating elements were evenly distributed in the ribs of the side walls and the back wall. The oven's side walls were equipped with air ventilators. In front of the oven, a computerised display was set up to gauge the temperature.
A thermostat was used to regulate the temperature. The stainless steel perforated shelves allowed for the installation of samples on top of them. Samples were dried in an oven to measure the moisture content of raw materials and their products.

Tray dryer
The heating unit, drying chamber, and centrifugal fan for air flow made up the tray drier. The dryer included a drying chamber, a heating element, and a fan. An enclosed box with a single door opening at the front served as the drying chamber. The drying room contained ten aluminium trays. In order to raise the temperature inside the drying chamber, six heating units were fitted. A circulating fan was used to move the hot air throughout the cabinet. In order to control the preferred temperature for the drying trials, a thermostatic controller (50 - 250oC) was also linked to the heating unit.

Oil uptake
Oil uptake was to obtained how many time (sec.) to be taken completely fried of potato/cucumber chips. It s percentage of oil absorption of chips in different oil case.

Oil uptake kinetics
Oil uptake kinetics was to obtained change of fried weight and initial weight per unit of time.

$$\text{Oil uptake kinetics} = \frac{Wf-Wi}{t}$$

Where
Wf=fried weight
Wi=initial weight
T=time

Result and discussion
In Table 1, experimental results on oil uptake kinetics and % of oil absorption in deep-fried chips that were fried in mustard oil and sunflower oil are presented. The oil uptake changed with respect to different pretreatments given to cucumber chips fried in mustard oil. It was found that sample T_1 having highest fried weight, oil absorption percentage and highest oil uptake kinetics as 25.0 g, 233.33% and 1.03, respectively after 17 second frying. Lowest fried weight, oil absorption percentage was found in sample T_2 as 18.5 g and 146.66%, respectively after 23 second frying, whereas lowest oil uptake kinetics was found in sample T_5 (0.37) after 39 second frying. The oil uptake changed with respect to different pretreatments given to cucumber chips fried in sunflower oil. It was found that sample T_1 having highest fried weight, oil absorption percentage and highest oil uptake kinetics as 23.0 g, 206.66% and 1.19, respectively after 13 second frying. Lowest fried weight, oil absorption percentage was found in sample T_5 as 15.0 g and 100.00%, respectively after 22 second frying, whereas lowest oil uptake kinetics was found in sample T_4 (0.24) after 33 second frying. The amount of oil on the surface of the dish also grows as the oil's viscosity and cooking duration do. Consequently, it is made easier for the oil to get into the food. (Del Re and Jorge, 2007) [19]. Reduced oil temperature lengthened frying times, and identical outcomes were seen when potatoes were vacuum-fried. (Garayo and Moreira, 2002) [1].

Table 1: Effect on pretreatment and frying in mustard oil and sunflower oil on oil uptake and oil uptake kinetics of cucumber chips at 180 °C

	Mustard oil					Sunflower oil				
Treatments	**I.W (g)**	**F.W (g)**	**Time (S)**	**Oil absorption (%)**	**Oil uptake kinetic**	**I.W (g)**	**F.W (g)**	**Time (S)**	**Oil absorption (%)**	**Oil uptake kinetic**
T1	7.5	25.0	17	233.33	1.03	7.5	23.0	13	206.66	1.19
T2	7.5	18.5	23	146.66	0.48	7.5	16.5	25	120.00	0.36
T3	7.5	21.5	22	186.66	0.64	7.5	21.5	20	189.33	0.70
T4	7.5	21.0	30	180.00	0.45	7.5	15.5	33	106.66	0.24
T5	7.5	22.0	39	193.33	0.37	7.5	15.0	22	100.00	0.34

I.W= Initial weight, F.W= Fried weight

The experimental data are presented in Table 2 for the percentage of oil absorption in deep-fried oil uptake and the oil uptake kinetics of cucumber chips fried in groundnut oil and canola oil. The oil uptake changed with respect to different pretreatments given to cucumber chips fried in groundnut oil. It was found that sample T_3 having highest fried weight, oil absorption percentage as 22.0 g and 193.33%, respectively after 23 second frying, whereas highest oil uptake kinetics was found in sample T_1 (0.89) after 14 second frying. Lowest fried weight, oil absorption percentage was found in sample T_2 as 17.0 g and 126.66%, respectively after 27 second frying, whereas lowest oil uptake kinetics was

found in sample T_5 (0.24) after 42 second frying. The oil uptake changed with respect to different pretreatments given to cucumber chips fried in canola oil. It was found that sample T_4 having highest fried weight, oil absorption percentage as 23.00 g and 206.66%, respectively after 37 second frying, whereas highest oil uptake kinetics was found in sample T_1 (0.62) after 16 second frying. Lowest fried weight, oil absorption percentage was found in sample T_3 as 15.5 g and 106.66%, respectively after 21 second frying, whereas lowest oil uptake kinetics was found in sample T_5 (0.25) after 44 second frying. The highest oil absorption percentage was found in mustard oil and groundnut oil, with the exception of T1 for groundnut oil. Sunflower and canola oils were less absorbed by the same cucumber chips when different types of treatment and different types of oils were used. Oils with larger percentages of saturated fatty acids in their composition are thought to absorb oil less readily. (Bordin *et al.*, 2013; Freire *et al.*, 2013) [18, 13]. With increased frying time, oil deterioration and absorption rises nonlinearly. (Saguy and Pintus, 1995) [17].

Table 2: Effect on pretreatment and frying in groundnut oil and canola oil on oil uptake and oil uptake kinetics of cucumber chips at 180 °C

	Groundnut oil					Canola oil				
Treatments	**I.W (g)**	**F.W (g)**	**Time (Second)**	**Oil absorption (%)**	**Oil uptake kinetic**	**I.W (g)**	**F.W (g)**	**Time (Second)**	**Oil absorption (%)**	**Oil uptake kinetic**
T1	7.5	20.0	14	166.66	0.89	7.5	17.5	16	133.33	0.62
T2	7.5	17.0	27	126.66	0.35	7.5	16.0	26	113.33	0.33
T3	7.5	22.0	23	193.33	0.63	7.5	15.5	21	106.66	0.38
T4	7.5	20.5	35	173.33	0.37	7.5	23.0	37	206.66	0.42
T5	7.5	17.5	42	133.33	0.24	7.5	18.5	44	146.66	0.25

I .W= Initial weight, F.W= Fried weight

Conclusion

The treatment T_1 fried in mustard oil in comparison to sunflower oil, groundnut oil, and canola oil was determined to have the highest oil absorption percentage and oil uptake kinetics. T_5 fried in sunflower oil had the lowest oil absorption rate among the treatments, whereas T4 fried in sunflower oil and T_5 fried in groundnut oil had the lowest oil uptake kinetics. Cucumber chips in sunflower oil were more impacted by $CaCl_2$, which resulted in a decreased oil absorption percentage.

References

1. Garayo J, Moreira R. Vacuum frying of potato chips. Journal of food engineering. 2002 Nov 1;55(2):181-191.
2. Krokida MK, Oreopoulou V, Maroulis ZB. Water loss and oil uptake as a function of frying time. Journal of food engineering. 2000 Apr 1;44(1):39-46.
3. Pedreschi F, Moyano P. Oil uptake and texture development in fried potato slices. Journal of Food Engineering. 2005 Oct 1;70(4):557-563.
4. Gamble MH, Rice P. Effect of pre-fry drying of oil uptake and distribution in potato crisp manufacture. International journal of food science & technology. 1987 Oct;22(5):535-548.
5. Rojo JA, Perkins EG. Cyclic fatty acid monomer formation in frying fats. I. Determination and structural study. Journal of the American Oil Chemists' Society. 1987 Mar;64(3):414-421.
6. Dueik V, Bouchon P. Vacuum frying as a route to produce novel snacks with desired quality attributes according to new health trends. Journal of food science. 2011 Mar;76(2):E188-195.
7. Maity T, Bawa AS, Raju PS. Effect of Vacuum Frying on Changes in Quality Attributes of Jackfruit (*Artocarpus heterophyllus*) Bulb Slices. International Journal of Food Science; c2014. p. 1-8.
8. Aladedunye F, Przybylski R, Niehaus K, Bednarz H, Matthäus B. Phenolic extracts from Crataegus× mordenensis and Prunus virginiana: Composition, antioxidant activity and performance in sunflower oil. LWT-Food Science and Technology. 2014 Nov 1;59(1):308-319.
9. Beig Mohammadi Z, Maghsoudlou Y, Safafar H, Sadeghi Mahoonak AR. Physicochemical properties and stability of oil extracted from three canola cultivars grown in Golestan province of Iran. Journal of Agricultural Science and Technology. 2012 May 10;14(3):577-586.
10. Dana D, Saguy IS. Mechanism of oil uptake during deep-fat frying and the surfactant effect-theory and myth. Advances in colloid and interface science. 2006 Dec 21;128:267-672.
11. Tian J, Chen J, Ye X, Chen S. Health benefits of the potato affected by domestic cooking: A review. Food Chemistry. 2016 Jul 1;202:165-175.
12. Ouchon PB, Pyle DL. Studying oil absorption in restructured potato chips. Journal of Food Science. 2004 Apr;69(3):FEP115-22.
13. Chatzilazarou A, Gortzi O, Lalas S, Zoidis E, Tsaknis J. Physicochemical changes of olive oil and selected vegetable oils during frying. Journal of Food Lipids. 2006 Mar;13(1):27-35.
14. Kalogianni EP, Karastogiannidou C, Karapantsios TD. Effect of potato presence on the degradation of extra virgin olive oil during frying. International journal of food science & technology. 2010 Apr;45(4):765-775.
15. Sosa-Morales ME, Orzuna-Espíritu R, Vélez-Ruiz JF. Mass, thermal and quality aspects of deep-fat frying of pork meat. Journal of Food Engineering. 2006 Dec 1;77(3):731-738.
16. Gopalan C, Shastri BVR, Balasubramaniam SC. Nutritive value of Indian food, Indian Council of Medical Res., Hyderabad, National Institute of Nutrition. 1982;18:251-253.
17. Saguy IS, Pinthus EJ. Oil uptake during deep-fat frying,, factors and mechanism. Food Technology. 1995;49(4):142-145.
18. Bordin K, Tomihe Kunitake M, Kazue Aracava K, Silvia Favaro Trindade C. Changes in food caused by deep fat frying-A review. Archivos latinoamericanos de nutricion. 2013 Mar;63(1):5-13.
19. Del Ré PV, Jorge N. Sunflower, soybean and corn oils behavior in frozen pre-fried coated meat product frying.

Ciência e Agrotecnologia. 2007;31:1774-1779. doi:10.1590/S1413-70542007000600002

20. Ferreira N, Poco J, Vo HT, Freire J, Silva CT. Visual exploration of big spatio-temporal urban data: A study of New York City taxi trips. IEEE transactions on visualization and computer graphics. 2013 Oct 16;19(12):2149-2158.