Evaluation of Five Potato Varieties for Producing French Fries

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ABSTRACT

The present study was conducted on five potato varieties named Diamont, Metro, Dido, Cara and Messi used for French fries production. The results showed a significant effect of variety on gross chemical composition, dry matter, specific gravity, colour, polyphenols and ascorbic acid contents. All studied potato varieties contained considerable amounts of carbohydrates, protein, fiber and could be considered good source of Mg, Na and K. Messi variety had the highest content of dry matter being 25.27% and specific gravity of 1.083 g/cm^3, on contrary to Dido variety which had the lowest dry mater and specific gravity being 16.49% and 1.061 g/cm^3, respectively. Noticeable amounts of polyphenols ranged between 66.24–102.61 mg /100 g and ascorbic acid (13.9–30.83 mg/100g fresh weight) could be figured out. Colour parameters revealed that, Cara had the highest lightness. Meanwhile, the highest redness was found in Dido and Messi varieties. French fries prepared from all studied varieties were accepted by panelists for all organoleptic properties especially fries prepared from Messi and Dido varieties which possess the highest and lowest levels of dry matter. Therefore, these two varieties were selected to investigate the effect of some suggested approaches that decline oil uptake during French fries processing. The results indicated that drying under vacuum at 60°C for 0.5 and 1 hr, blanching at 95°C for 4min, after soaking in NaCl 3% for 50min, and increasing the thickness of potato sticks could significantly decrease oil uptake of potato sticks during Frech fries processing.

Key words Potato varieties, French fries, , chemical composition, oil uptake

INTRODUCTION

Potato *(Solanum tuberosum*) is one of the world's major agricultural crops and it is consumed daily by millions of people from diverse cultural backgrounds (Garayo & Moreira, 2002). Potatoes serve as an inexpensive source of energy, vitamin C, minerals such as potassium and high quality proteins in relation to other vegetables protein (Burton, 1989). However, their value in the human diets is often underestimated or ignored. Potatoes not only contain a great variety of nutrients, but also have many small molecular weight compounds (flavonoids, carotenoids, phenolic compounds and vitamins), whose many beneficial effects on health have been recognized (Mouille & Charrondiere, 2009, Wegener *et al.,*2015).

Deep fat frying is used for manufacturing a variety of potato products, the most important ones being French fries and potato chips. The largest proportion of both products is made in the traditional way by starting from fresh potatoes, while a more recent alternative uses potato granules or flour which are shaped into the desired size of stick and slices, respectively (Gutcho,1973). In the process based on raw potatoes, the frying step combines heat treatment at high moisture is responsible for gelatinization of starch, softening of potato tissue and least partial in activation of enzymes. Dehydration leads to formation of a dry crust with its typical porous structure and crisp textures. This crust extends only over the outermost layer of French fried potatoes, but comprises the whole products in the case of potato chips (Baumann & Eschert, 1995) .Textural changes during frying process are the result of many physical, chemical, and structural changes produced in this complex process unit operation, which includes heat and mass transfer together with chemical reactions. Good-quality French fries must have a crispy crust of about 1–2 mm, where, most of the oil is located, and a wet, soft center, like a cooked potato (Moreira *et al.*,1999, Troncoso *et al*., 2009). French fries colour is the result of the Maillard reaction which depends on the content of superficial reducing sugars, temperature and frying time (Marquez & Anon, 1986).

Blanching is a processing step whereby potatoes are heated in steam or water for 2 to 3 min.

This inactivates enzymes and prolongs the storage life of frozen fries. Moreover, blanching reduces the subsequent cooking time. Blanching also makes the colour more uniform after frying and it forms a layer of gelatinized starch that limits oil absorption and improves texture (Moreira, *et al.,* 1999).

Oil consumption during frying, especially saturated fat is considered as a major factor increasing health risks such as coronary heart disease (CHD), cancer, diabetes and hypertension, and even linked to increased causes of death. Fried foods contribute a significant proportion of the total fat consumed in the Western world. Yet, aside from their high caloric value, fried foods can be nutritious and favourably comparing with other cooking methods such as baking and boiling. Fried foods are popular due to their taste, distinctive flavour, aroma and crunchy texture. (Saguy & Dana, 2003).

Nutritionally, fat consumption is considered as the main factor of over weight and development of coronary diseases in the population. On the other hand, high oil content in fried products will increase production costs, so, this work aimed to compare some potato varieties used in French fries processing in terms of gross chemical composition, minerals, specific gravity, colour, polyphenols and ascorbic acid contents. The effect of some suggested pretreatments in reducing oil absorption during French fries processing were also studied to make such products more acceptable to health-conscious consumer.

MATERIALS AND METHODS

Materials

Five potato varieties namely Diamont, Metro, Dido,Messi and Cara were obtained from General Company for Agricultural Agencies, Egypt . Ten kilograms of each variety transported to the pilot plant of Food Science and Technology Department, Faculty of Agriculture, Alexandria University, Egypt, in dark polyethylene bags and kept at room temperature (22±2C°) until used.

Refined sunflower oil in polyethylene terephthalate (PET) bottles were purchased from Alexandria market, Egypt. Analytical grade chemicals were used in the present study.

Technological methods

Preparation of potato samples for analysis Potato tubers were washed, hand peeled using stainless steel knives then minced and directly used.

Preparation of French fries The potato tubers were washed, hand-peeled using stainless steel knives to remove a thin outer layer of peel and the peeled tubers were cut along the long axis with a manual operated French fry cutter into two different dimensions (9×9×60 mm strips and 12×12×60 mm) . The potato strips with dimensions (12×12×60 mm) were divided to four parts one of them used as the control sample and the others were exposed to the following treatments

1- Drying under vacuum at 60°C for different periods (0.5 and 1 hr)

2- Blanching in water at 95°C for 4 min.

3- Soaking in 3% NaCl / 50 min, followed by blanching in water at 95°C for 4 min.

Frying process of potato strips was carried out at 180°C for 10 min until desired golden colour was reached.

Analytical methods

Gross chemical composition Moisture, ash, crude protein (N×6.25), crude ether extract and crude fiber of fresh potato were determined as described in the AOAC (2003) unless otherwise stated. Nitrogen-free extract (NFE) was calculated by difference.

Total sugars Total sugars (reducing and non reducing) of fresh potato were determined using Lane and Enon procedure as stated in the AOAC (2003).

Minerals Fe, Mg, Ca, Zn,Cu and Mn potato were determined in fresh potato as described in the AOAC (2003) using Perkin Elmer Atomic Absorption Spectrophotometer (Model 2380). On the other hand, Na and K were determined using flame photometer (Model PEP7, England).

Specific gravity Specific gravity was determined according to Kaul *et al.*(2010) by PM 2050 Weigher (Weltech international ltd). Potatoes were weighed in air and water. Temperature of atmosphere and water was also taken into consideration.

Dry matter Dry matter was determined according to Rimac–Brncic, *et al.* (2004) by drying in a convection oven at 105°C until constant weight .Samples were weighed every 5 min until a constant weight was obtained.

Ether extract Oil content of processed French fries was determined after 16 hr by soxhlet extraction with petroleum ether (40–60°C)(AOAC, 2003).

Ascorbic acid Ascorbic acid was determined in fresh potato according to the AOAC (2003) procedure using 2,6 dicholorophenol, indophenol dye.

Extraction of total phenolic compounds Ten grams of fresh potato minced sample were macerated in absolute methanol (100 ml) for 24 hr at room temperature according to Ziada (2002). The extracts were filtered; the filtrates were evaporated under vacuum using vacuum rotary evaporator (type 349/2 Jobling Laboratory Division) at 45ºC and weighed to determine the extract yield and these extracts were used for polyphenols determination after adjusting volume in a volumetric flask.

Determination of total phenolic contents The total phenolic contents were determined in the potato extracts following the Folin-Ciocalteu method (Singleton & Rossi, 1965). The reaction mixtures contained 0.1 ml of extract, 7.9 ml distilled water, 0.5 ml of Folin- Ciocalteu's reagent, and 1.5 ml of 20% anhydrous sodium carbonate solution. The contents were mixed and kept in dark for 2 hrs. The absorbance of the blue coloured samples were read at 765 nm. Total phenolics content was calculated as gallic acid equivalent (GAE) and the values were expressed as mg of gallic acid/ 100g sample.

Colour The colour parameters which include lightness (L^*), redness (a^*) and yellowness (b^*) of all processed French fries samples were evaluated by a Hunter Lab Ultra Scan VIS model, colorimeter (USA).

Sensory evaluation Colour, taste, odour, texture and overall acceptability of processed French fries were assessed by 15 panelists from Food Science and Technology Department, Faculty of Agriculture, Alexandria University. The panelists were asked to score the aforementioned attributes according to a standard hedonic rating scale from 9 (like extremely) to 1 (dislike extremely) according to Kramer and Twigg (1970) .

Statistical analysis Statistical analysis was done by ANOVA, Factor t-test and L.S.D. procedures according to Steel & Torrie (1980). The SAS software package (Version 9.13, 2008) was used.

RESULTS AND DISCUSSION

Gross chemical composition of potato varieties The results of gross chemical composition (on dry weight basis) of five investigated potato varieties namely, Diamont, Metro, Dido, Messi and Cara are shown in Table (1). There were significant differences among all potato varieties in terms of chemical composition. Dido variety had the highest moisture content (83.17%),while Messi had the lowest content (73.06%). All the potato samples had a considerable amount of protein ranged from 6.57 % in Cara to 10.71 % in Dido variety. Meanwhile, a little content of crude ether extract was found in all studied varieties, whereas Cara variety contained the lowest fat content comparing with the other varieties. Noticeable contents of ash and crude fiber were found in all potato varieties, where the two components ranged from 2.73 to 5.23 % and from 6.93 to10.34 %, for ash and crude fiber, respectively. No significant differences could be traced in nitrogen free extract (NFE) content among Cara, Diamond, Messi and Metro varieties. Meanwhile, Dido variety represented the lowest content (70.67%). Total sugar contents in all po-

Table 1: Gross chemical composition and total sugar content in potato varieties (on dry weight basis)

Component (%)	Potato varieties				
	Diamont	Metro	Dido	Messi	Cara
Moisture	$74.42^{d}\pm0.44$	$77.08^{a}\pm0.18$	$83.17^{a}\pm0.82$	$73.06^{e}\pm0.05$	$75.68^{c}\pm0.33$
Protein	$7.55^{c}\pm0.59$	$8.03^{c}\pm0.25$	$10.71^{a}\pm0.61$	$9.60^{b}\pm0.28$	$6.57^{d}\pm0.41$
Crude ether extract	$1.14^{b}\pm0.25$	$2.44^{a}\pm0.22$	$2.96^{a}\pm.029$	$1.29^{b}\pm0.19$	$1.01^{b}\pm0.21$
Ash	$2.89^{c}\pm0.16$	$4.72^{b}\pm0.25$	$5.23^{a}\pm0.31$	$2.73^{c}\pm0.07$	$4.33^{b\pm}0.14$
Crude fiber	$9.38^{ab}\pm0.39$	$8.34^{b}\pm$o.26	$10.34^{a}\pm0.36$	$8.73^{b}\pm0.89$	$6.93^{c}\pm0.31$
NFE*	$79.04^{a}\pm1.51$	$76.47^{a}\pm1.31$	$70.76^{b}\pm1.51$	$77.65^{a}\pm1.14$	$81.16^{a}\pm1.2$
Total Sugars	$2.86^{c}\pm0.14$	$3.96^{b}\pm0.27$	$2.79^{d}\pm0.16$	$1.89^{d}\pm0.07$	$4.76^{a}\pm.013$

* NFE = Nitrogen free extract (calculated by difference)

Means within a row not sharing the same letter are significantly different at $P\leq0.05$.

tato samples ranged from 1.89 to 4.76 %, whereas, Cara variety had the highest amount. Meanwhile, Messi and Dido represented the lowest content of the total sugars being 1.89 and 2.79 % for Messi and Dido, respectively.

Mineral contents Significant differences in mineral contents could be figured out among the studied potato varieties as shown in Table (2). The results reveal that all potato varieties contained considerable amount of Na (70.70–127.60 mg/100g), K (30.20–44.50 mg/100g),Ca (14.90–33.60 mg/ 100g), Mg (80.90–139.90 mg/100g) and Fe (8.80–16.13 mg/100g),while they contained a slightly little amount of Cu, Zn and Mn.

Dry matter and specific gravity Dry matter content is one of important factors affected both processing efficiency and the quality of the finished product of French fries . If the dry matter content is too low, the French fries will be too soft. Meanwhile, too high dry matter caused hardness and dryness of the product. The dry matter content partly determines the texture and oiliness of the finished products, thus determining consumer preference. High dry matter content is always associated with high specific gravity. Table (3) shows the dry matter and specific gravity of all studied potato varieties. The results indicate that there were significant differences among the potato varieties in both of specific gravity and dry matter content. Dry matter could be ordered descendingly as follows: Messi, Diamond, Cara, Metro and Dido. The studied varieties show the same order in specific gravity where Messi had the highest one being 1.128 g/cm^3 .Meanwhile, Dido variety exhibited the lowest specific gravity (1.061 g/cm^3). These results reflected the strong and positive correlation between dry matter and specific gravity in potatoes. It is worthy to mention that specific gravity of tubers is an important determinant of processing quality. The specific gravity of tubers is directly correlated to their dry matter content. The higher dry matter content, the lower water content and high specific gravity.

Table 3: Specific gravity and dry matter of potato varieties

Potato variety	Specific gravity (g/cm^3)	Dry matter (%)
Diamond	1.083^{c}±0.02	25.57^{b}± 0.44
Metro	1.074^{d}±0.02	22.19^{d}±0.18
Dido	1.061^{e}±0.01	16.49^{e}± 0.18
Messi	1.128^{a}±0.20	26.86^{a}±0.55
Cara	1.091^{b}±0.01	24.32^{c}±0.33

Means within a column not sharing the same letter are significantly different at P≤0.05

Ufheil & Escher (1996) reported that, potatoes used for frying should be low in sugar and moisture and have a specific gravity of 1.08g/cm^3 or more with 1.1g/cm^3 preferred. Some sugars are required to provide colour and flavour, but if it is too high the sugar and fat produce bitter flavours. An increase in the density of potato tuber also leads to a decrease in fat absorption.

Polyphenols and ascorbic acid Table (4) shows the total polyphenols and ascorbic acid contents in potato varieties .The results indicated the presence of considerable amounts of total polyphenols and ascorbic acid in all studied potato varieties. The highest amount (on fresh weight basis) of polyphenols was found in Messi variety (102. 61 mg/100g) followed by Cara (90.75 mg/100g), Merto (73.09 mg/100g) and finally the lowest

Table 2: Mineral contents of potato varieties (mg/100g)

Minerals	Potato varieties				
	Diamont	Metro	Dido	Messi	Cara
Na	105^{b}.30 ±0.10	93^{c}.20± 0.05	70.70^{e}±0.10	127.60^{a}±0.10	80.30^{d} ±0.05
K	44.50^{a}±0.10	33.90^{d}±0.10	39.12^{c}±0.02	41.17^{b}±0.02	30.20^{e}±0.05
Ca	30.20^{b}±0.05	27.30^{d}±0.05	14.90^{e}±0.10	28.90^{c}±0.05	33.60^{a}±0.10
Mg	116.70^{c}±0.10	122.60^{b}±0.10	139.90^{a}±0.10	97.20^{d}±0.10	80.90^{e}±0.10
Fe	16.13^{a}±0.03	11.12^{b}± 0.02	9.92^{d}±0.02	8.80^{e}±0.05	10.13^{c}±00.10
Cu	1.22^{a}±0.04	0.93^{c}±0.01	0.81^{d}±0.02	0.99^{b}± 0.02	0.52^{e}±0.02
Zn	5.17^{b}±0.02	3.18^{e}±0.03	3.92^{d}±0.02	4.17^{c}± 0.02	5.96^{a}±0.04
Mn	3.04^{c} ±0.03	2.16^{e}±0.02	2.81^{d}±0.10	4.29^{a}±0.10	3.31^{b}±0.10

Means within a row not sharing the same letter are significantly different at P≤0.05.

Table 4: Polyphenols and ascorbic acid (mg/100 g fresh weight) in potato varieties

Potato variety	Components	
	Polyphenols	Ascorbic acid
Diamond	68.28^{d}± 0.99	30.83^{a}± 0.61
Metro	73.09^{c}± 0.94	18.23^{c}±0.91
Dido	66.24^{d}±0.62	22.16^{b}± 0.61
Messi	102.61^{a}± 1.1	18.86^{c}±0.55
Cara	90.75^{b}±0.56	13.90^{d}±0.70

Means within a column not sharing the same letter are significantly different at P≤0.05

amount was detected in Diamond and Dido being (68.28 and 66.24 mg/100g, respectively).The data revealed significant differences in ascorbic acid content among the potato varieties. Potato varieties could be arranged according to their concentrations of ascorbic acid in descending order as follows: Diamond, Dido, Messi, Metro and Cara. According to Haase & Weber (2003), ascorbic acid content in potato was found to vary due to variety. The decline of ascorbic acid during processing of French fries and potato chips showed a high product dependency. Moreover, the intensity of ascorbic acid losses and degradation depends on the processing design. They also stated that, freshly harvested potato tubers may contain more than 30 mg vitamin C/100 g (fresh weight), whereas the level in long term stored samples (6–9 months) can drop down below 10 mg vitamin C/100 g (fresh weight). During preparation and processing, further degradation takes place by enzymatic oxidation, thermal degradation and diffusion into blanching and cooking water. Galdon *et al.*(2012) found that ascorbic acid ranged from 10.4-31.1 mg/100g depending on potato varieties.

Colour Colour parameters (lightness, redness and yellowness) of processed French fries were measured by Hunter lab instrument (Table 5). It was obvious that the highest value of lightness was found in Cara variety on contrary to Metro variety which possessed the lowest lightness, whereas, the other varieties lied in between. The studied varieties could be arranged according to redness value in the following descending order: Dido, Messi, Metro, Diamond and Cara. Notwithstanding, Messi variety exhibited the highest value in yellowness on contrary to Dido variety which had the lowest yellowness.

Organoleptic characteristics Table (6) summarizes the organoleptic properties of processed French fries samples. The data confirm the high overall acceptability of all potato samples by panelists especially Dido and Messi varieties, this perhaps due to low content of total sugars in both varieties. Kabira & Lemaga (2003) confirmed that high content of sugar in potato varieties resulted in dark frying colour and this results in a bitter taste, which is unacceptable in the production of French fries.

Suggested approaches to reduce oil uptake in potato French fries Messi and Dido varieties were ranked by panelists as the most acceptable along with they represented highest and lowest

Table 5: Hunter colour parameters of processed French fries

Potato variety	L*	a*	b*
Diamond	71.52^{b}± 0.02	2.62^{d}±0.02	27.65^{b}± 0.05
Metro	68.11^{e}±0.05	3.23^{c}±0.02	27.7^{b}± 0.20
Dido	69.56^{d}±0.05	4.13^{a} ±0.03	24.60^{d}±0.05
Messi	70.79^{c}±0.09	3.86^{b} ±0.01	31.53^{a}± 0.03
Cara	72.23^{a}±0.04	2.12^{e} ±0.01	26.44^{c}±0.04

L* = Lightness a* = Redness b* =Yellowness
Means within a column not sharing the same letter are significantly different at P≤0.05

Table 6: Organoleptic characteristics of processed French fries.

Potato variety	Organoleptic properties				Overall acceptability
	Taste	Odour	Texure	Colour	
Diamond	4.70^{b}±0.99	5.30^{b}±0.76	4.70^{c}±0.77	5.20^{c}±0.81	6.20^{b}±0.43
Metro	6.80^{a}± 0.65	6.70^{ab}± 0.54	6.40^{b}±0.76	6.80^{b}±0.44	6.50^{b}±0.44
Dido	8.40^{a}±0.54	8.50^{a}±0.98	8.10^{a}±0.72	8.80^{a}±0.85	8.60^{a}± 0.54
Messi	8.30^{a}±0.98	8.00^{a}±0.83	8.80^{a}±0.43	9.30^{a}±0.96	8.50^{a}±0.86
Cara	7.30^{a}± 0.76	6.60^{ab}± 0.98	6.10^{b}±0.66	7.00^{b}±0.85	7.40^{ab} ±0.83

Means within a column not sharing the same letter are significantly different at P≤0.05

content of dry matter. Accordingly, the aforementioned varieties were selected for further study to investigate how the oil uptake during processing of French fries can be declined.

Effect of thickness Two different thicknesses of potato sticks (9×9×60mm and 12×12×60 mm) were investigated. The data shown in Table (7) reveal that, variation of thick-cut sticks of potato had a significant effect on oil uptake during French fries processing, whereas, in the two varieties of potato, sticks with 12×12×60 mm thickness absorbed less oil than the thinner ones (9×9×60mm). It was clear that the oil uptake increased significantly in thinner sticks by 2.83 and 1.54% in Dido and Messi varieties, respectively. Consequently, potato sticks with thickness 12×12x60 mm in both varieties were selected for further study to investigate the effect of other pretreatments applied in the present study. These results are in agreement with Blumentahl (1991), who found that the thickness of the potato strips is an important factor affecting the overall oil content of French fries. Thick-cut strips (12 mm or bigger) absorb less oil than thin-cut strips. The oil content in French fries decreases with increasing cross-section area of potato sticks, and oil is restricted to the surface of the sticks. Cracks and rough surfaces increase the surface area and thus increase the oil absorption. Ideally, all potato sticks need to be cut to the same dimensions, with a fairly uniform cross section and, to a lesser extent, length to allow for uniform cooking.

Effect of vacuum drying The effect of drying on potato sticks using under vacuum at 60°C/ different periods (0.5 and 1 hr) prior frying process on the oil uptake was investigated and the results are shown in Table (8). The data revealed that decreasing of moisture content in both varieties resulted in a significant decrease in oil uptake during French fries preparation. The reduction in moisture content in Dido variety from 83.17 to 78.92 and 66.07% after 0.5 and 1 hr of vacuum drying was associated with a significant reduction in oil uptake by 6.5 and 18.4%, respectively. The same results were obtained in Messi variety, whereas, lowering moisture content from 73.06 to 66.84% after 0.5 hr and to 58.83% after 1 hr of vacuum drying caused a significant reduction in oil uptake of French fries by 9.6 and 16.5 %, respectively. These results indicate the inverse relation between dry matter content and oil uptake during French fries processing. In accordance, Lamberg *et al.* (1990) found that drying the surface of the potato strips before frying reduced the oil uptake in French fries, whereas drying reduced the oil uptake by 7 to 29% (for 1 min frying) and by 15 to 40% (for 5 min frying). Drying causes a 'skin' to form on the surface of the potato strip and this reduce vapour transport through the surface layer. Moyano *et al.* (2002) reported that drying of potatoes before frying using microwave, hot-air treatment and baking has resulted in a significant reduction in oil content of different products. Furthermore, Garayo & Moreira (2002) reported that, much attention has been given to the use of vacuum frying which may be an option to produce fried potatoes with low oil content and desired texture and flavour characteristics.

Table 7: Effect of thickness on oil uptake of French fries from Messi and Dido varieties

Potato variety	Oil uptake (%)	
	A*	B*
Dido	$43.85^{b} \pm 0.92$	$45.13^{a} \pm 0.76$
Messi	$30.81^{b} \pm 0.56$	$31.29^{a} \pm 0.42$

Means within a row not sharing the same letter are significantly different at P≤0.05
A*= Samples with thickness (12×12×60 mm) .
B*= Samples with thickness (9×9×60 mm).

Table 8: Effect of drying on oil uptake of French fries from Messi and Dido varieties

Potato variety	Moisture (%)	Oil uptake (%)
Dido		
Drying time/hr		
0.0	$83.17^{a} \pm 0.82$	$43.85^{a} \pm 0.92$
0.5hr	$78.92^{b} \pm 0.53$	$40.98^{b} \pm 0.72$
1.0hr	$66.07^{d} \pm 0.52$	$35.78^{c} \pm 0.24$
Messi		
Drying time/hr		
0.0	$73.06^{c} \pm 0.62$	$30.81^{d} \pm 0.56$
0.5 hr	$66.84^{d} \pm 0.55$	$27.86^{e} \pm 0.51$
1.0 hr	$58.83^{e} \pm 0.54$	$25.74^{f} \pm 0.54$

Means within a column not sharing the same letter are significantly different at P≤0.05

Effect of blanching and soaking in NaCl solution The results in Table (9) illustrate the effect of blanching in water and blanching in water after soaking in 3% NaCl / 50 min prior to frying on oil uptake of French fries from Messi and Dido vari-

Table 9: Effect of blanching on oil uptake of French fries from Messi and Dido varieties

Potato variety	Treatments		
	A*	B*	C*
Dido	43.85[a]±0.92	41.72[b]±0.91	39.28[c]±0.23
Messi	30.81[a]±0.56	30.5[a]±0.14	27.83[b]±0.58

Means within a row not sharing the same letter are significantly different at P≤0.05

A*= Control (Without blanching)
B*= Blanching in water (95C°/4min)
C*= Blanching in water (95C°/4min) , after soaking in 3%NaCl /50 min.

eties. Blanching in water at 95°C/4 min of Dido variety caused a significant reduction in oil uptake reaching 4.8%, meanwhile soaking in 3% NaCl /50 min before blanching under the same condition reduced the oil uptake in potato French fries by 10.4 %. No significant differences in oil uptake could be traced in Messi after blanching in water at 95°C /4 min. On the other hand, soaking in 3% NaCl / 50 min before blanching reduced the oil uptake by 9.6%. These results are in agreement with Califano & Calvelo (1987) ,who stated that the blanching step prior to frying in potato chip processing improves the colour and texture, and reduces, in some cases, the oil uptake by gelatinization of the surface starch. Aguilar *et al.*(1997) reported that blanching at low temperature enhances pectin methyl esterase (PME) activity and is another option proposed that affects both textural quality and oil uptake. Also, Bunger *et al.* (2003) found that soaking of potato strips in 3% NaCl solution for 50 min significantly reduced oil uptake from 0.13 to 0.10 g oil/g dry matter and increased the measured texture parameters (hardness to penetrate both crusts, and both work and initial rigidity). Furthermore, Moyano *et al.* (2002) found that soaking of potato strips in NaCl solution reduced oil uptake in French fries. Rimac- Brncic *et al.* (2004) found that the oil content of all fried potatoes was significantly affected by blanching procedure.

In the light of data presented here, it can be concluded that French fries prepared from Messi and Dido potato varieties are well accepted from the organoleptic point of view. In addition, drying under vacuum at 60 °C for 0.5 and 1 hr, blanching at 90 °C for 4 min after soaking in NaCl 3% for 50 min and increase the thickness of potato sticks of the aforementioned varieties could significantly decrease oil uptake during preparation of French fries.

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تقييم خمسة أصناف من البطاطس لانتاج الأصابع المحمرة

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أجريت هذه الدراسة على خمسة أصناف من البطاطس(الديامونت، المترو، الديدو، الكارا، الميسي) المستخدمة لعمل أصابع البطاطس المحمرة . تمت دراسه التركيب الكيماوى التقريبى و المعادن و اللون و نسبه المادة الجافة و الكثافة النوعية ومحتوى كل من المركبات الفينولية وحامض الأسكوربيك فى البطاطس الخام ، كما تم مقارنة اللون و الخواص العضوية الحسية للأصناف الخمسة. أظهرت النتائج وجود تأثير معنوى لاختلاف الأصناف على كل الخواص السابق ذكرها كما أشارت الدراسة أيضاً الى احتواء أصناف البطاطس موضوع الدراسة على كميات محسوسة من البروتين و الكربوهيدرات و الألياف كما يمكن أن تعتبر مصدراً جيداً لكل من الماغنيسيوم والبوتاسيوم. أظهرت النتائج وجود أعلى نسبه من المادة الجافة فى الصنف ميسي حيث بلغت نسبتها ٢٧,٢٧ ٪ مع كثافة نوعية مقدارها ١,٠٨٣ جم/ سم^{٣} بينما كانت أقل نسبة للمادة الجافة فى صنف الديدو حيث بلغت ١٦,٤ ٪ مع كثافة نوعية مقدارها ١,٠٦١ جم/ سم^{٣}. تبين احتواء جميع أصناف البطاطس على كميات محسوسة من كل من المركبات الفينوليه (٦٦,٢٤ – ١٠٢,٦١ مجم/ ١٠٠ جم وزن رطب) و حامض الأسكوربيك (١٣,٩ – ٣٠,٨٣ مجم/ ١٠٠ جم وزن رطب) . تم قياس اللون لعينات البطاطس المحمرة باستخدام جهاز هانتر وذلك لتقدير كل من شدة إضاءة اللون ونسبة كل من اللون الأحمر و الأصفر حيث كان الصنف كارا أعلى الأصناف فى خاصية الإضاءة وكان الصنف ديدو هو الأعلى فى نسبة اللون الأحمر و الأقل فى الأصفر بينما كان الصنف ميسى هو الأعلى فى نسبة اللون الأصفر .حازت البطاطس المحمرة المعدة من الأصناف الخمسة وبخاصه الصنفان ميسي وديدو قبولاً لدى المحكمين فى جميع الخواص العضوية الحسية .بناء على النتائج السابقة فقد تم اختيار صنفي الميس والديرو لدراسه تأثير بعض المعاملات المقترحة لخفض نسبه الزيت أثناء التحمير و التى تمثلت فى التجفيف تحت تفريغ على ٦٠ م$^{\circ}$/ ٠,٥ – ١ ساعه، السلق على ٩٥ م$^{\circ}$/ ٤ دقائق قبل و بعد الغمر فى محلول٣٪ كلوريد صوديوم لمده ٥٠ دقيقه كذلك تأثير سمك أصابع البطاطس المعدة على نسبة الزيت الممتص. تبين من الدراسة أن لكل من المعاملات السابقة تأثيرات معنوية ملحوظه على خفض نسبه الزيت الممتص أثناء التحمير.