# The Amount of Fat Absorbed by Non-Stored and Stored Potatoes after Frying and Roasting

Ruta Galoburda, Irisa Murniece, and Daina Karklina

Abstract—In potato processing the common cooking methods are frying and roasting. During frying several chemical and physical changes take place, including oil and water interaction which is related to the heat-mass transfer phenomena wherefrom the nutritional quality of the product is changed. The aim of the research was to evaluate oil absorption by roasted and fried potatoes. Oil absorption and water loss of five common Latvian potato varieties Lenora, Brasla, Imanta, Zile and Madara was evaluated A two-year research was conducted during two periods: just after harvesting and after six months of storage. Three commonly used cooking methods were applied: deep fat frying, shallow frying and roasting in oven. Time-temperature was controlled. Fat content in fried potatoes in 100 g of DW by the types of frying differs significantly (p < p0.001). A close linear correlation was found between the fat content and moisture ( $\mathbf{R}^2=0.815$ ).

*Index Terms*—Deep-fat frying, fat content, potatoes, roasting, shallow frying, variety.

#### I. INTRODUCTION

Traditionally, potatoes are a central component of warm meals in many European countries [1]. In the research conducted by Nordic and Baltic countries' authorities on food consumption patterns, it was discovered that in Latvia the level of fried potato consumption compared with neighbouring countries was one of the highest [2].

Over the past 40 years, changes in lifestyle and requirements for convenience, accompanied by an increased consumption of pasta and rice, have led to a considerable decrease in potato consumption in most Northern and Central European countries (decrease by 30–45% from 1961 to 2002). However, high annual intake of potatoes above 80 kg per capita is maintained even today in the Baltic countries, Poland, the Netherlands, Ireland, and the UK [3].

From the Latvian national comprehensive food consumption survey, carried out during 2007-2009 it was found that consumption of fried potatoes was 88 g per day for males, and 53 g per day for females and deep-fat fried (French fries) 45 g per day and 20 g per day respectively [4]. Males in Latvia consume fried potatoes 0.62 times more than

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R. Galoburda, I. Murniece, and D. Karklina are with the Faculty of Food Technology, Latvia University of Agriculture, Liela street 2, Jelgava, Latvia (e-mail:ruta.galoburda@llu.lv, irisa.murniece@llu.lv, daina.karklina@llu.lv). females and deep-fat fried potatoes -0.44 times more than females [5].

Frying is one of the oldest cooking methods. That complex operation represents a process, which involves several chemical and physical changes including starch gelatinization, protein denaturation, water vaporization and crust formation. This process affects oxidative and hydrolytic degradation and polymerization of the oil. Together with heat transfer, mass transfer takes place. This is characterized by the oil movement into the product, as well as the water movement from the product into the oil [6], [7].

During the frying process, the water present in the raw material evaporates and is partially replaced by oil, constituting up to 40% of the finished product, and consequently influencing its properties [8].

Deep-fat frying is widely used, because consumers prefer the taste, appearance and texture of fried food products. However, these products contain a substantial amount of fat [6], [7].

Shallow frying is a very common cooking method used in Latvia – frying of raw potatoes in very small amount of oil [9].

The aim of the research was to evaluate oil absorption by roasted and fried potatoes.

# II. MATERIALS AND METHODS

In cooperation with the State Priekuli Plant Breeding Institute (Latvia), five table potato varieties which can be used for the production of fried potato products were selected for the study: 'Lenora', 'Brasla', 'Imanta', 'Zile,' and 'Madara'. 'Madara' is an early maturity variety; 'Lenora' is mid-early, while 'Zile', 'Brasla' and 'Imanta' are representatives of mid-late varieties. The 'Madara' and 'Zile' varieties are the oldest ones used in the research, developed in 1984, 'Brasla' was developed in 1990, Lenora in 1995, while the newest variety 'Imanta' was developed in 2006 [9]. Detailed description of each potato variety is presented in Table I.

Tuber samples of varieties were analyzed after harvesting and after six months of storage. Potatoes were stored at an air temperature of  $5 \pm 1$  °C and at a relative air humidity of  $80 \pm 5\%$ .

The tubers of selected varieties were produced in the fields of the State Priekuli Plant Breeding Institute. The potatoes were grown in sandy loam soil with a  $pH_{KCl}$  of 6.1 and in an allowable amount of phosphorus and potassium. In the first year the ratio of N : P : K was 13 : 10 : 15, but in the second year it was 11 : 19 : 20. The soil cultivation was performed using the agrotechnology according to the existing crop management.

Comparing the years of potato growing, the atmospheric temperature during the growing season was very similar, but the rainfall level differed in both growing years [9].

Potato tubers of approximately similar size (4–6 cm) and weight of 200±15 g each were selected, washed, hand-peeled and cut in three ways: for shallow frying potatoes were sliced into  $0.7 \times 1.0$  cm and 3–4 cm long strips, fried at 150±5 °C for 7.0±0.3 min, while for deep fat frying they were sliced into  $0.6 \times 0.6$  cm and 4–5 cm long strips and fried at a temperature of 180±5 °C for 4.0±0.3 min. Potatoes prepared for roasting were cut horizontally into halves and roasted at a temperature of 210±5 °C for 25±1 min.

TABLE I: DESCRIPTION OF THE STUDIED POTATOES [5]

Potato	Shape	Colour of skin	Suitability	
Totato	of	and flesh of	for Cooking	Variety type
variety	tubers	potato tubers	type	
'Zīle'	Oval	skin and flesh	B-BC*	medium-late
		yellow		
'Brasla'	Round	skin and flesh	BC	medium-late
		yellow		
'Madara'	round	skin yellow	В	early
	oval	and flesh light		
		yellow	_	
'Lenora'	round	skin and flesh	В	medium-early
	oval	yellow	500	
'Imanta'	oblong oval	skin yellow	BC-C	medium-late
		with pink eyes		
	_ · u	flesh white		

\*B type – for frying, boiling (medium-mealy), C type – for most of meals (mealy), and BC type – for frying, boiling and other types of cooking.

Sunflower seed oil "*Floriol*" produced in Hungary was used for frying. The sample potatoes were prepared according to three types of frying: roasting in an oven (potato and oil ratio -1: 0.009), frying in a pan - in a small amount of oil (1: 0.04) and in a deep-fat fryer - in a high amount of oil (1: 4.9). To control oil absorption in fried and roasted potatoes, samples were weighed before and after frying, and the roasting process was applied.

Throughout the oven and deep fat frying procedure, the time and temperature were recorded by USB TC-08 Thermocouple Data Logger PICO-Technologist equipment [9].

Information about the sample handling procedure is described by Murniece *et al.* [9].

The moisture content was determined by ISO 6496:1999 standard method [10]. Each sample was heated in an oven at  $103\pm2$  °C for 4 h. During this period water evaporation corresponded to weight loss. The fat content was determined by ISO 6492:1999 [11].

Fat uptake of dish k prepared by method p related to 100 grams of ingredients in ready-to-cook condition in grams (C(k, p)) was calculated by using equation (1):

$$C_{(k,p)} = (D_{(k,p)} \times e_{(k,p)} - D_{(k)}, \qquad (1)$$

where:  $D_{(k)}$ - content of fat per 100 grams edible portion of total ingredients used for preparation of dish k in ready-to-cook condition (analyzed) in grams;

 $\boldsymbol{D}_{(\boldsymbol{k},\boldsymbol{p})}$  - content of fat per 100 g edible portion of dish k

prepared by method p (analyzed) in grams;  $e_{(k,p)}$  - weight yield factor of dish k, edible part, prepared by method p.

Weight yield factor of dish k, edible part, prepared by method p(e(k, p)), equation (2):

$$e_{(k,p)} = \frac{Z_{(k,p)}}{U_{(k)}}$$
(2)

where:  $Z_{(k,p)}$ - amount of dish k, edible part, prepared by method p in grams;  $U_{(k)}$ - total amount of ingredients (ready-to-cook) without cooking medium (water, fat) according to the base recipe of dish k in grams [12].

To compare the obtained results of chemical analyses for non-fried and differently fried potatoes, recalculation was carried out from g 100 g<sup>-1</sup> fresh weight (FW) per g 100 g<sup>-1</sup> dry weight (DW), but for correlation analyses, the results were used in g  $100g^{-1}$  FW. The results represent the average value and standard deviation from both potato harvest years.

For statistical analysis, the data were processed using the S-PLUS 6.1 Professional Edition software. The data were presented as a mean  $\pm$  standard deviation (SD). The differences between independent groups were specified by two way analysis of variance (ANOVA), and values of P < 0.05 were regarded as statistically significant. In the case of establishing statistically significant differences, homogeneous groups were determined by Tukey's multiple comparison test at the level of confidence  $\alpha = 0.05$ .

# III. RESULTS AND DISCUSSION

Dry matter content determined for uncooked potatoes was significantly different at the time of harvesting and after storage (p<0.005). Changes of dry matter content during storage period can be related to the increase in the transpiration rate of the tubers due to tuber life processes and sprouting [13], 14].

Significant differences in dry matter content were found after harvesting between both varieties (p<0.05) and cooking methods (p<0.001) for the research years. The results of dry matter content are shown in Table II.

Evaluating the content of dry matter (DM) in fried potatoes by different frying types (Table II), which are roasted in an oven, the content of dry matter is within the range of 24.35% ('Lenora', before storage) to 43.05% ('Imanta', after storage). The content of dry matter in shallow-fried potatoes is higher than in those roasted in an oven. It can be explained by the different ways of cutting the potatoes for each frying type (described in section "Materials and Methods") and its content is within the range of 27.76% ('Lenora', before storage) to 48.05% ('Imanta', before storage). In deep-fat fried potatoes the content of dry matter is the highest from 45.46% ('Zīle', after storage) to 63.18% ('Brasla', before storage).

The increase of dry matter in fried potatoes is connected with moisture evaporation from the outer layer of potatoes during the process of frying, thus forming a crispy crust [15]. It is also influenced by the conditions and length of storage. The potatoes which are cut into smaller pieces have a greater surface area and due to that more water evaporates from the product during the frying process.

The results obtained after mathematical data processing indicate that there exist significant differences in the content of dry matter in all the applied types of thermal treatment (p<0.001) and varieties (p=0.009). Substantial differences are observed in potato variety 'Lenora' which has the lowest content of dry matter in comparison with the potato varieties 'Brasla' and 'Imanta'. Evaluating the differences in the content of dry matter according to the types of heat treatment, the results obtained, indicate a significant difference of mean values of the content of dry matter among potato genotypes after shallow frying (p=0.005).

TABLE II: DRY MATTER CONTENT OF THE STUDIED POTATO SAMPLES, %

Type of		1 <sup>st</sup> study year		2 <sup>nd</sup> study year	
frying	Potato variety	Before	After	Before	After
		storage	storage	storage	storage
	' <b>7</b> 71a'	$20.16 \pm$	$23.14\pm$	$24.42\pm$	$24.82 \pm$
	Zile	0.06	0.06	0.12	0.08
	(D	$23.36\pm$	$26.86 \pm$	$25.60\pm$	$25.85 \pm$
ed	Diasia	0.03	0.08	0.09	0.04
oka	·M	$18.93 \pm$	$25.83\pm$	$21.77\pm$	$22.54\pm$
100	Iviauara	0.07	0.07	0.01	0.01
U	'Lenora'	$19.48 \pm$	$22.54\pm$	$20.31\pm$	$25.21\pm$
		0.10	0.18	0.01	0.06
	'Imanta'	$24.72\pm$	$25.58\pm$	$24.42 \pm$	$24.61 \pm$
		0.05	0.03	0.12	0.01
	·771'	$31.26\pm$	$30.67 \pm$	$37.59 \pm$	$34.38 \pm$
	Life	0.09	0.14	0.01	0.04
	'Bracla'	$36.04\pm$	$37.56 \pm$	$33.36\pm$	$34.26 \pm$
ac	Diasia	0.08	0.23	0.06	0.06
stin	'Madara'	$28.46 \pm$	$39.06 \pm$	$35.83 \pm$	$31.29\pm$
oas	Ividuala	0.07	0.14	0.07	0.13
R	'Lonora'	$24.35\pm$	$34.73\pm$	$27.55\pm$	$33.66 \pm$
	Lenora	0.11	0.17	0.05	0.06
	'Imanta'	$34.70\pm$	$43.05\pm$	$32.71 \pm$	$33.40  \pm$
	manta	0.07	0.20	0.08	0.07
	' <b>7</b> īle'	$36.55 \pm$	$33.90\pm$	$40.72\pm$	$37.80\pm$
	ZIIC	0.12	0.21	0.09	0.08
ŝ	'Drasla'	$38.88 \pm$	$42.52\pm$	$41.06 \pm$	$38.59\pm$
yir	Diasia	0.08	0.09	0.03	0.05
ŕfr	'Madara'	$35.99 \pm$	$40.03\pm$	$39.16 \pm$	$35.38\pm$
lov		0.09	0.16	0.06	0.08
hal	'Lenora'	$30.19 \pm$	$27.76 \pm$	$32.51\pm$	$31.95\pm$
S		0.08	0.18	0.04	0.11
	'Imanta'	$48.05 \pm$	$35.44\pm$	$37.73\pm$	$37.16 \pm$
	IIIaiita	0.11	0.15	0.13	0.13
	'7īle'	$57.49\pm$	$45.46 \pm$	$59.17\pm$	$58.07 \pm$
	Zile	0.10	0.20	0.08	0.06
Deep-fat frying	'Brasla'	$53.89\pm$	$50.98\pm$	$63.18\pm$	$56.41 \pm$
		0.12	0.11	0.05	0.66
	'Madara'	$50.75\pm$	$59.32\pm$	$56.57 \pm$	$50.55\pm$
		0.06	0.20	0.08	0.06
	'Lenora'	$59.81  \pm$	$50.75\pm$	$55.83 \pm$	$48.55\pm$
		0.10	0.25	0.16	0.06
	'Imanta'	$61.91 \pm$	$46.44\pm$	$57.27\pm$	$61.75\pm$
		0.13	0.25	0.04	0.15

Comparing to the results of fat content in seven different potato varieties reported by Jim énez *et al.*, currently researched potatoes have higher fat content [16]. Fat content in raw / uncooked potatoes in 100 g of DW is from  $0.12\pm0.06$  g ('Brasla') to  $0.87\pm0.09$  g ('Lenora') and in 100 g of FW from  $0.03\pm0.014$  g ('Brasla') to  $0.22\pm0.021$  g ('Madara') (Table III).

Fat content in fried potatoes in 100 g of DW (Table III) by the types of frying differs significantly (p<0.001) and it is the following: in oven roasted potatoes it is within the range of 0.47 g ('Lenora') to 4.25 g 100 g<sup>-1</sup> DW ('Imanta'). In shallow fried potatoes – from 6.86 g ('Lenora') to 16.00 g 100 g<sup>-1</sup> DW ('Brasla') and in deep-fat fried potatoes – from 14.11 g ('Zīle') to 21.12 g 100 g<sup>-1</sup> DW ('Lenora'). Fat content increases considerably in shallow fried and in deep-fat fried potatoes. In roasted potatoes the absorbed amount of oil is from 0.1 g to 1.4 g 100 g<sup>-1</sup> FW, which is much lower than in the shallow fried potatoes – from 2.0 g to 3.5 g 100 g<sup>-1</sup> FW and in deep-fat fried potatoes – from 3.8 g to 5.4 g 100 g<sup>-1</sup> FW (Fig. 1).

The differences in the amount of the absorbed oil by the types of frying are affected by the content of dry matter and starch in potatoes, the type of potato cutting, the amount of oil used for frying and the length of frying time.

TABLE II: FAT CONTENT OF THE STUDIED POTATO SAMPLES, G 100 G-1 EW

	Type of		1 <sup>st</sup> study year		2 <sup>nd</sup> study year	
Inying Formula values Definition After isotrage storage storag	fruing	Potato variety	Before	A ftor	Before	After
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	nymg	I office variety	storage	storage	storage	storage
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		'Zīle'	$0.77\pm$	$0.71\pm$	$0.27\pm$	$0.28\pm$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$			0.77 ±	0.71	0.27 ±	$0.28 \pm$ 0.03
$ \begin{array}{c} \begin{tabular}{ c c c c c c c } & 0.71 & 0$			0.25	$0.0^{-1}$	$0.03 \\ 0.12 +$	0.03
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		'Brasla'	0.15	0.05	0.12	0.03
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} 0\\ 0\\ 0\\ 0\\ 0\\ \end{array} \end{array} \\ \begin{array}{c} \mbox{'Madara'} \\ \mbox{'Lenora'} \\ \mbox{'Lenora'} \\ \mbox{'Imanta'} \\ \mbo$	oke		0.15	0.03 + 0.83 +	0.00 + 0.25 +	0.03
$ \begin{array}{c} 1 \\ \hline 1 \\ 1 \\$	000	'Madara'	0.01	$0.03 \pm 0.08$	0.03	$0.24 \pm 0.34$
$ \begin{array}{c} \begin{array}{c} \mbox{imanta}^{1} & \mbox{imanta}$	Cn		0.10 + 0.80 +	$0.86 \pm$	0.05 + 0.30 +	0.31 + 0.14 + 0.14 + 0.014 + 0.0014 +
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	,	'Lenora'	0.11	0.09	0.07	0.03
$ \frac{1}{1000} \frac{1}{100$			0.47 +	0.82 +	0.18 +	0.22 +
$ \begin{array}{c} \mbox{Sigma} \label{eq:second} \begin{tabular}{ c c c c c c } \hline & & & & & & & & & & & & & & & & & & $		'Imanta'	0.20	0.11	0.09	0.03
$ \begin{array}{c} \mbox{STR} \\ \mbox{STR}$			3.07+	0.78+	0.51+	0.73+
$ \begin{array}{c} \mbox{Brasla'} & 2.58 \pm & 1.10 \pm & 1.53 \pm & 0.92 \pm \\ 0.88 & 0.09 & 0.13 & 0.10 \\ & \mbox{Madara'} & 2.39 \pm & 0.97 \pm & 0.47 \pm & 1.29 \pm \\ 0.20 & 0.25 & 0.08 & 0.34 \\ & \mbox{Jenoral} & 3.78 \pm & 1.00 \pm & 0.93 \pm & 0.79 \pm \\ & \mbox{Jenoral} & 0.46 & 0.06 & 0.08 & 0.15 \\ & \mbox{Jmanta'} & 4.25 \pm & 0.91 \pm & 0.72 \pm & 0.57 \pm \\ & \mbox{Od} & 0.10 & 0.19 & 0.08 \\ \end{array} $		'Zīle'	0.54	0.14	0.11	0.12
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	50	~	2.58 +	1.10 +	1.53 +	0.92 +
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		'Brasla'	0.88	0.09	0.13	0.10
$ \begin{array}{c} & & & & & & & & & & & & & & & & & & &$	ting		$2.39 \pm$	$0.97 \pm$	$0.47 \pm$	$1.29 \pm$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Das	'Madara'	0.20	0.25	0.08	0.34
$ \begin{array}{c} \mbox{Lenora}^{1} & 0.46 & 0.06 & 0.08 & 0.15 \\ \mbox{Imanta}^{2} & 0.91 \pm & 0.72 \pm & 0.57 \pm \\ 0.06 & 0.10 & 0.19 & 0.08 \\ \mbox{Imanta}^{2} & 13.11 \pm & 7.43 \pm & 9.36 \pm & 11.56 \pm \\ 0.15 & 0.29 & 0.07 & 0.187 \\ \mbox{Imanta}^{2} & 16.00 \pm & 8.06 \pm & 8.60 \pm & 10.99 \pm \\ 0.22 & 0.18 & 0.10 & 0.15 \\ \mbox{Imanta}^{2} & 10.78 \pm & 6.88 \pm & 9.84 \pm \\ 0.24 & 0.16 & 0.31 & 0.12 \\ \mbox{Imanta}^{2} & 11.36 \pm & 6.86 \pm & 10.83 \pm & 11.00 \pm \\ \mbox{Imanta}^{2} & 0.28 & 0.18 & 0.22 & 0.46 \\ \mbox{Imanta}^{2} & 11.36 \pm & 8.26 \pm & 12.69 \pm \\ \mbox{Imanta}^{2} & 15.95 \pm & 14.11 \pm & 18.07 \pm & 16.38 \pm \\ \mbox{Imanta}^{2} & 15.95 \pm & 14.11 \pm & 18.07 \pm & 16.38 \pm \\ \mbox{Imanta}^{2} & 17.15 \pm & 16.67 \pm & 14.17 \pm & 16.96 \pm \\ \mbox{Imanta}^{2} & 0.20 & 0.23 & 0.12 & 0.42 \\ \mbox{Imanta}^{2} & 18.09 \pm & 19.21 \pm & 14.88 \pm & 21.12 \pm \\ \mbox{Imanta}^{2} & 18.09 \pm & 19.21 \pm & 14.88 \pm & 21.12 \pm \\ \mbox{Imanta}^{2} & 14.75 \pm & 15.30 \pm & 18.84 \pm & 14.67 \pm \\ \mbox{Imanta}^{2} & 14.75 \pm & 15.30 \pm & 18.84 \pm & 14.67 \pm \\ \mbox{Imanta}^{2} & 0.14 & 0.17 & 0.05 & 0.14 \\ \end{array}$	Ř	( <b>T</b> )	$3.78\pm$	$1.00\pm$	$0.93 \pm$	$0.79 \pm$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Lenora	0.46	0.06	0.08	0.15
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		'Imanta'	$4.25 \pm$	$0.91 \pm$	$0.72\pm$	$0.57 \pm$
$ \begin{array}{c} \begin{tabular}{ c c c c c c c } & 13.11 \pm & 7.43 \pm & 9.36 \pm & 11.56 \pm \\ 0.15 & 0.29 & 0.07 & 0.187 \\ \hline & 0.15 & 0.29 & 0.07 & 0.187 \\ \hline & 0.15 & 0.29 & 0.07 & 0.187 \\ \hline & 0.22 & 0.18 & 0.10 & 0.15 \\ \hline & 0.22 & 0.18 & 0.10 & 0.15 \\ \hline & 0.24 & 0.16 & 0.31 & 0.12 \\ \hline & 0.28 & 0.18 & 0.22 & 0.46 \\ \hline & 0.18 & 0.22 & 0.66 & 0.13 \\ \hline & 0.18 & 0.22 & 0.66 & 0.13 \\ \hline & & 0.18 & 0.22 & 0.66 & 0.13 \\ \hline & & & & & & & & \\ \hline & & & & & & & &$			0.06	0.10	0.19	0.08
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		· 7=1- ?	$13.11 \pm$	$7.43 \pm$	9.36±	$11.56 \pm$
$ \begin{array}{c} \begin{array}{c} & \mbox{`Brasla'} & 16.00 \pm & 8.06 \pm & 8.60 \pm & 10.99 \pm \\ 0.22 & 0.18 & 0.10 & 0.15 \\ 13.95 \pm & 10.78 \pm & 6.88 \pm & 9.84 \pm \\ 0.24 & 0.16 & 0.31 & 0.12 \\ \end{array} \\ \begin{array}{c} \mbox{`Madara'} & 11.36 \pm & 6.86 \pm & 10.83 \pm & 11.00 \pm \\ 0.28 & 0.18 & 0.22 & 0.46 \\ \end{array} \\ \begin{array}{c} \mbox{`Imanta'} & 8.70 \pm & 11.36 \pm & 8.26 \pm & 12.69 \pm \\ 0.18 & 0.22 & 0.66 & 0.13 \\ \end{array} \\ \begin{array}{c} \mbox{`Zīle'} & 15.95 \pm & 14.11 \pm & 18.07 \pm & 16.38 \pm \\ 0.07 & 0.20 & 0.02 & 0.08 \\ \end{array} \\ \begin{array}{c} \mbox{`Brasla'} & 17.15 \pm & 16.67 \pm & 14.17 \pm & 16.96 \pm \\ 0.08 & 0.19 & 0.08 & 0.10 \\ \end{array} \\ \begin{array}{c} \mbox{`Madara'} & 17.73 \pm & 15.45 \pm & 14.35 \pm & 17.77 \pm \\ 0.20 & 0.23 & 0.12 & 0.42 \\ \end{array} \\ \begin{array}{c} \mbox{`Madara'} & 18.09 \pm & 19.21 \pm & 14.88 \pm & 21.12 \pm \\ 0.14 & 0.22 & 0.18 & 0.24 \\ \end{array} \\ \begin{array}{c} \mbox{`Imanta'} & 14.75 \pm & 15.30 \pm & 18.84 \pm & 14.67 \pm \\ 0.14 & 0.17 & 0.05 & 0.14 \\ \end{array} \end{array}$		Zile	0.15	0.29	0.07	0.187
$ \begin{array}{c} \begin{tabular}{ c c c c c c c } \hline Brasia & 0.22 & 0.18 & 0.10 & 0.15 \\ \hline Madara' & 13.95 \pm & 10.78 \pm & 6.88 \pm & 9.84 \pm \\ 0.24 & 0.16 & 0.31 & 0.12 \\ \hline Lenora' & 11.36 \pm & 6.86 \pm & 10.83 \pm & 11.00 \pm \\ 0.28 & 0.18 & 0.22 & 0.46 \\ \hline Imanta' & 8.70 \pm & 11.36 \pm & 8.26 \pm & 12.69 \pm \\ 0.18 & 0.22 & 0.66 & 0.13 \\ \hline Z\overline{1}le' & 15.95 \pm & 14.11 \pm & 18.07 \pm & 16.38 \pm \\ 0.07 & 0.20 & 0.02 & 0.08 \\ \hline Brasla' & 17.15 \pm & 16.67 \pm & 14.17 \pm & 16.96 \pm \\ 0.08 & 0.19 & 0.08 & 0.10 \\ \hline Madara' & 17.73 \pm & 15.45 \pm & 14.35 \pm & 17.77 \pm \\ 0.20 & 0.23 & 0.12 & 0.42 \\ \hline Madara' & 18.09 \pm & 19.21 \pm & 14.88 \pm & 21.12 \pm \\ 0.14 & 0.22 & 0.18 & 0.24 \\ \hline Imanta' & 14.75 \pm & 15.30 \pm & 18.84 \pm & 14.67 \pm \\ 0.14 & 0.17 & 0.05 & 0.14 \\ \hline \end{array} $	00	(D1-)	$16.00\pm$	$8.06 \pm$	$8.60\pm$	$10.99 \pm$
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c}$	yin	Brasia	0.22	0.18	0.10	0.15
$ \begin{array}{c} \begin{tabular}{ c c c c c c c } \hline & & & & & & & & & & & & & & & & & & $	ŕ	'Madara'	$13.95\pm$	$10.78 \pm$	$6.88 \pm$	$9.84\pm$
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Shallow	wiadara	0.24	0.16	0.31	0.12
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		'Lenora'	$11.36\pm$	$6.86 \pm$	$10.83 \pm$	$11.00\pm$
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$			0.28	0.18	0.22	0.46
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		(Imanta)	$8.70\pm$	$11.36 \pm$	$8.26 \pm$	$12.69\pm$
$ \begin{array}{c} {}^{\circ}Z\overline{1}le^{,\circ} & 15.95\pm 14.11\pm 18.07\pm 16.38\pm \\ 0.07 & 0.20 & 0.02 & 0.08 \\ {}^{\circ}Brasla^{,\circ} & 17.15\pm 16.67\pm 14.17\pm 16.96\pm \\ 0.08 & 0.19 & 0.08 & 0.10 \\ {}^{\circ}Madara^{,\circ} & 17.73\pm 15.45\pm 14.35\pm 17.77\pm \\ 0.20 & 0.23 & 0.12 & 0.42 \\ {}^{\circ}Lenora^{,\circ} & 18.09\pm 19.21\pm 14.88\pm 21.12\pm \\ 0.14 & 0.22 & 0.18 & 0.24 \\ {}^{\circ}Imanta^{,\circ} & 14.75\pm 15.30\pm 18.84\pm 14.67\pm \\ 0.14 & 0.17 & 0.05 & 0.14 \\ \end{array} $		manta	0.18	0.22	0.66	0.13
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	Deep-fat frying	'Zīle'	$15.95 \pm$	$14.11\pm$	$18.07  \pm$	$16.38\pm$
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} 0\\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \\ \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ $			0.07	0.20	0.02	0.08
$ \begin{array}{c} \begin{array}{c} & 0.08 & 0.19 & 0.08 & 0.10 \\ & 17.73 \pm & 15.45 \pm & 14.35 \pm & 17.77 \pm \\ & 0.20 & 0.23 & 0.12 & 0.42 \\ & 18.09 \pm & 19.21 \pm & 14.88 \pm & 21.12 \pm \\ & 0.14 & 0.22 & 0.18 & 0.24 \\ & 14.75 \pm & 15.30 \pm & 18.84 \pm & 14.67 \pm \\ & 0.14 & 0.17 & 0.05 & 0.14 \\ \end{array} $		'Brasla'	$17.15\pm$	$16.67\pm$	$14.17 \pm$	$16.96 \pm$
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \\ \\ \end{array} \end{array} \\ \begin{array}{c} \\ \end{array} \end{array} \\ \begin{array}{c} \\ \end{array} \end{array} \\ \begin{array}{c} \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \begin{array}{c} \\ \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \end{array} \\ \begin{array}{c} \\ \end{array} \\ $		Diasia	0.08	0.19	0.08	0.10
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} 0.20 \\ 0.23 \\ 0 \end{array} \\ \begin{array}{c} 0.21 \\ 0.14 \end{array} \\ \begin{array}{c} 0.20 \\ 0.23 \\ 0.12 \\ 0.12 \\ 0.14 \end{array} \\ \begin{array}{c} 0.22 \\ 0.18 \\ 0.24 \\ 0.14 \\ 0.17 \\ 0.05 \end{array} \\ \begin{array}{c} 0.42 \\ 0.12 \\ 0.42 \\ 0.12 \\ 0.12 \\ 0.14 \end{array} \\ \begin{array}{c} 0.21 \\ 0.14 \\ 0.17 \\ 0.05 \\ 0.14 \end{array} \\ \begin{array}{c} 0.12 \\ 0.42 \\ 0.12 \\ 0.12 \\ 0.12 \\ 0.14 \end{array} \\ \begin{array}{c} 0.12 \\ 0.1$		'Madara'	$17.73\pm$	$15.45 \pm$	$14.35\pm$	$17.77 \pm$
$ \begin{array}{c} \hline & \\ \hline \\ \hline$		11100010	0.20	0.23	0.12	0.42
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		'Lenora' 'Imanta'	$18.09\pm$	$19.21\pm$	$14.88 \pm$	$21.12\pm$
'Imanta' $\begin{array}{c} 14.75 \pm & 15.30 \pm & 18.84 \pm & 14.67 \pm \\ 0.14 & 0.17 & 0.05 & 0.14 \end{array}$			0.14	0.22	0.18	0.24
0.14 0.17 0.05 0.14			$14.75\pm$	$15.30\pm$	$18.84\pm$	$14.67\pm$
			0.14	0.17	0.05	0.14



A close linear correlation was found between the fat content and moisture ( $R^2$ =0.815) (Fig. 2).

Lower loss in weight was found in roasted potatoes, but

higher in deep-fat fried potatoes. The results of the research are as follows: in roasted freshly harvested potatoes the weight loss was within the range of 20% ('Madara') to 31% ('Zīle') and that of stored and afterwards roasted potatoes is within the range of 15% ('Imanta') to 30% ('Madara'); in shallow fried freshly harvested potatoes the loss was from 27% ('Imanta') to 37% ('Zīle') and in spring in potatoes fried after storage – from 16% ('Madara') to 29% ('Lenora'); in freshly harvested deep-fat fried potatoes, the loss in weight was from 40% ('Zīle') to 55% ('Imanta') and in those fried after storage – from 39% ('Imanta') to 57% ('Lenora').



Fig. 2. Correlation between moisture content and fat content of roasted and fried potatoes.

# IV. CONCLUSION

Evaluating the fat content by the types of frying, significant differences in fat content were observed in roasted potatoes by harvest years (p<0.001) and storage (in freshly harvested potatoes before storage and stored potatoes) (p<0.05). During roasting and frying process, the amount of oil absorbed was significant (p<0.001). Weight loss differed significantly by the types of frying (p<0.001).

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