THE EFFECTS OF FRYING ON POTATOES PHYSICO CHEMICAL, SENSORY AND TEXTURAL PROPERTIES

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Abstract. The aim of the study was to investigate the physico-chemical, sensory and textural properties of fried potatoes. For this study, the thermal treatment was performed using two types of oils (sunflower oil and palm oil). The frying was lead for 8 samples (different shapes), with the processing time of 7 and 10 minutes. Sensory analysis was performed on a target group of 25 panelists. Textural analysis aimed to characterize four texture parameters: hardness, cohesiveness, springiness and chewiness. Also, for each sample was determined the amount of dry matter losses after frying.

Keywords: fried potatoes, sunflower oil, palm oil, frying, texture, sensory characteristics

INTRODUCTION

The vegetable products market is rather a complex market and it is the only agricultural commercial area that works in line with the current principles sale - purchase. This shows favorable characteristics of a long-term development, especially due to supply and demand (Budică, 2005). The potato is one of the four most important crops in the world and it is an important food in the human diet (Solano Solis., 2007). From the point of view of ONU and FAO, the potato is one of the viable solutions for present and future to combat poverty and world hunger (Chiru, 2011). The importance of cultivating potatoes, keeping them as an important food in most geographic cultures, but also identifying known directions for uses (as feed or industry use - Morar, 1999). Also through new ways of exploiting (source of antioxidants, biodegradable plastics, active pharmaceutical ingredients), keeps this vegetable accessible to people developing (Chiru, 2013). The potato tuber contains approx. 25% dry matter, especially starch (Berindei, 1999, Morar, 1999). The tuber contains almost all the major vitamins, especially vitamin C. Therefore, for the months of winter and spring, the potato is the main source of vitamins for the human body (Berindei, 1999).

The starch content and also its structure is different from one type of potato to another. The potato starch consists of amylose (15-25%) and amylopectin (75-85%) (Hodisan, Timar, 2010). The potato is an agricultural plant with very high demands of temperature, soil moisture and atmospheric humidity (Bărăscu et al., 2013), but Romania has areas with favorable environmental conditions for potatoes (Berindei, 1999) such as: plain in the south of the country, the sands of Oltenia, the west and northwest plain (Bran, 2011). The industrial processing of potatoes has passed to a higher form of use (production of bioethanol - Hodisan, Timar, 2010), developing new products such as flakes and fried foods (chips), semi-fried (pommes frites), freezing or preservation in fluids. The objective of this study was to analyze changes in physico-chemical, sensory and textural properties of potatoes by frying heat treatment using sunflower oil and palm oil.

MATERIALS AND METHODS

The potatoes were purchased at 2.5 kg per bag from a hypermarket in Galati, Romania. The potatoes were produced and grew in our country by SC Production AGRICOM-M SRL. Sunflower oil and palm oil were purchased from a hypermarket in Galati.

Preparation of samples. There were prepared a total of 8 samples. These were encoded according to the used material, the cutting mode and the frying oil used.

Table 1

Formulation (g) of experimental products

Sample	Sharpe samples	Oil type	Frying time
RFS7	Sliced	Sunflower oil	7 minutes
RFS10	Sliced	Sunflower oil	10 minutes
RP7	Sliced	Palm oil	7 minutes
RP10	Sliced	Palm oil	10 minutes
CPFS7	French fries	Sunflower oil	7 minutes
CPFS10	French fries	Sunflower oil	10 minutes
CPP7	French fries	Palm oil	7 minutes
CPP10	French fries	Palm oil	10 minutes

Sensory analysis. For sensory analysis the method used was the scoring method, which consists of the use of a scale (1-10) to assess the perceived intensity of sensory attributes of the products. The study was based on a total of 25 untrained panelists, prepared only in terms of understanding the questionnaire that would have to complete. Each questionnaire was handed out to completion in a cozy room, with each person in part, to ensure that tasters do not influence each other. The samples were equally distributed and laid on white plates. The questionnaire was developed in order to include visual attributes, taste, touch, etc. The sensory attributes listed in the questionnaire allowed to do a general characterization of the product and providing a proper assessment of the overall product quality.

In terms of visual appearance, the color of samples was interpreted in relation to the actual color of samples depending on the time of frying (white - yellow, gold, golden - reddish tint). After visual interpretation, consumers have tasted the product. The taste impressions were related to chewiness, adhesiveness presented (in the second part of mastication) and the taste samples (during mastication and after swallowing). After swallowing the panelist was left a few seconds so that he could gave a thoughtful response on sensory attribute called aftertaste.

Textural analysis. The texture can be defined as a parameter that contains all the rheological and structural attributes of product perception by mechanical, tactile, and where is adequate even auditory and visual (Ndungu, 2007).

Although sensory methods are the primary means of determining the textural characteristics relevant to consumers, the complexity of sensory analysis had led to the development of instrumental methods. The underlying assumption is that the parameters derived from empirical methods for assessing texture refers to the perceived texture (Misael & José, 2006). For the instrumental analysis, the samples were left at room temperature without modifying theirs shape, such as sliced and French fries, with the initial weight of each sample of 250 grams, a low weight due to heat treatment compared to the

initial amount. The proper mechanical analysis was performed using the texturometer CT3 Brookfield.

There had been three determinations for each sample, using an accessory strands cut with a special cutter (TA53 code), for textural analysis of cut, with 40 mm in length. The speed cut applied by the device was 1 mm/s, the return speed was 1 mm/s and pre-test-speed was 2 mm/s. The test was conducted in a double cut on a 5 mm distance with a rate data collection of 20 points/s.

Physico - chemical analysis. *Determination of dry matter.* The analysis was achieved using the oven drying method to constant mass, at a temperature of 100-105ºC, according SR.ISO 1442:2010. *Determination of the loss during the thermal treatment.* Each initial sample was composed of 250 grams of potatoes. After frying, the potatoes were placed to drain into a plastic container, and after this step, each sample was reweighed.

RESULTS AND DISCUSSION

Sensory analysis. The results of the sensorial analysis are showed in Table 2.

Table 2.

The results of the sensorial analysis

Sensorial attribute	RFS7	RFS10	RP7	RP10	CPFS7	CPFS10	CPP7	CPP10
Aspect	7.0	9.0	9.5	9.8	8.5	9.2	9.6	9.6
Color	8.0	8.4	9.8	10	9.2	9.5	9.7	9.5
Crispiness	8.2	8.7	9.4	10	8.5	8.8	10.0	9.5
Hardness	8.5	8.4	8.6	10	7.8	9.0	9.2	9.8
Fracturability	8.0	9.0	7.6	8.0	7.0	8.0	8.0	9.2
Chewiness	7.5	9.0	9.0	10	8.3	9.0	8.4	10
Taste	8.0	8.5	9.0	10	8.5	8.7	8.8	9.5
Adhesiveness	7.5	8.4	9.2	9.8	8.5	9.0	9.2	8.5
"Aftertaste"	8.0	8.5	9.0	10	8.5	9.0	9.5	9.5

By analyzing the sensory attribute named aspect, had resulted that the sample RP10 was most appreciated, while the sample RFS7 received the lowest score. Equal values were recorded by the samples RPFS10 and CPP7.
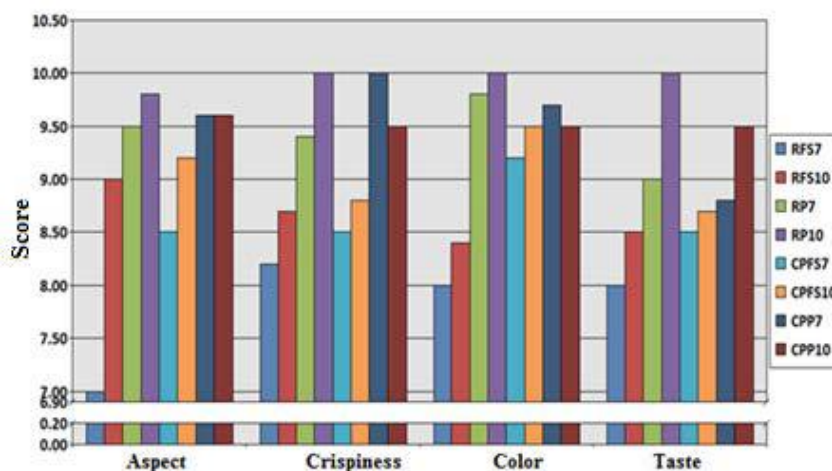

Fig. 1. The results of sensory analysis of the panelists at the first contact with the product

The analyze of the attribute called - "crispy" - *crispiness*, was intended to see "how loud" were the samples at the first bite, although this attribute is especially a characteristic "French fries" of potatoes or for potatoes as chips. That's why samples RP10 and CCP7 received top marks, because there were crunchy samples, while samples CPFS7 and RFS7 were the softest.

Regarding the color perceived by panelists, RP10 sample received a higher score than the other samples. The fried samples gained a yellowish-reddish tint color; therefore the samples were fully supported and accepted by tasters. The samples RFS7 and RFS10 were least appreciated because they had very little color to yellow and gave the impression of boiled potatoes, not fried. The maximum score for taste was received by RP10 sample, making it the tastiest sample, followed by CPP10. The lowest values were recorded for samples RFS10 and RFS7, hence the fact that these two samples were less tasty. The samples with the lowest hardness were CPFS7 and RFS10.

A high adherence had been obtained for the sample RP10. This sample had the most acceptable sensory attributes. The sample CPP7 was more accepted than RP7. The samples that presented adhesiveness to the palate and teeth were: CCP10, CPFS7, RFS10 and RFS7.

Finally, there were calculated an average of all sensory attributes in order to justify the correlation of the obtained sensory data. From the graphical representation (Fig. 2) it can be seen that the panelists' preferences were directed to RP10 sample, followed by RF10 and CCP10. Less appreciated were the samples CPFS7, RFS10, CPFS10 and RFS7, because this samples had recorded the lowest overall score.
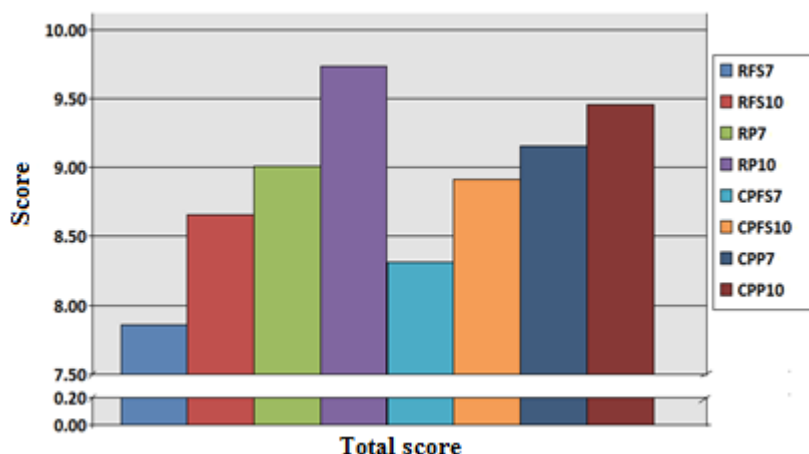

Fig. 2. The average of the sensorial attribute

Textural analysis. We analyzed four texture parameters: hardness, cohesiveness, springiness and chewiness. *Hardness.* The samples RP7 and RFS10 had the highest hardness than the other samples; CPFS10 and CPFS7 samples had the lowest hardness. This attribute was performed according to its acceptability as a basic feature for the French fried potatoes.

Springiness. The samples CPFS7 and RP10 had higher springiness than the other samples, and were followed by the samples RF10 and CPFS10. RFS7 and CPP10 samples showed a lower elasticity compared to the other samples.
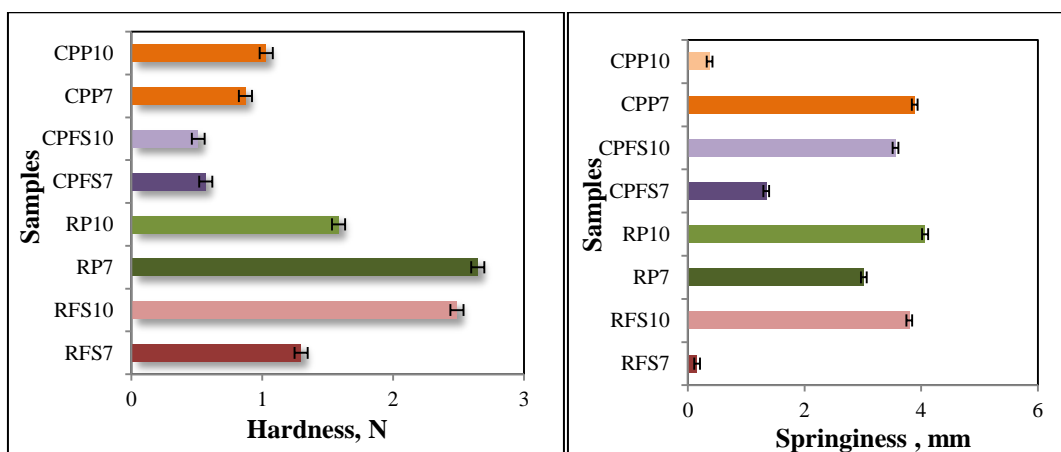
Fig. 3-4. Textural analysis - *Hardness* and *Springiness*
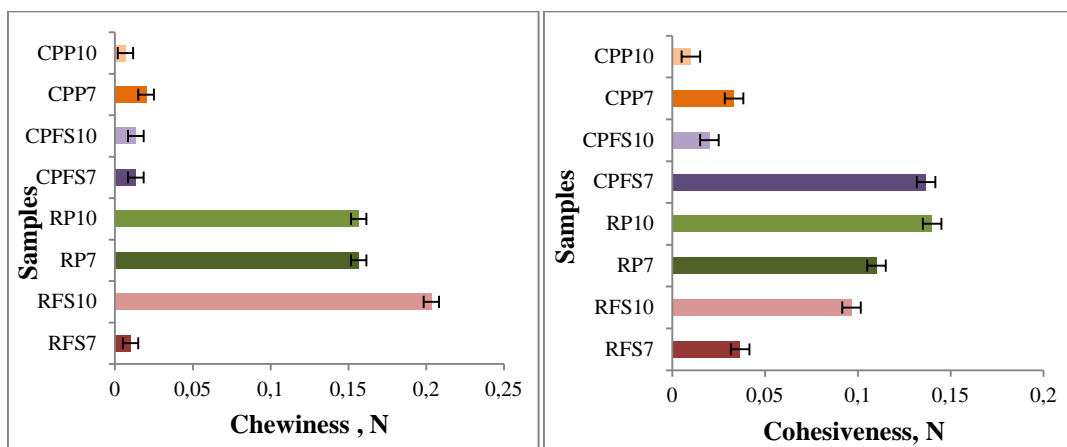
Fig. 5-6. Textural analysis - *Cohesiveness* and *Chewiness*

Cohesiveness. The samples RP10 and CPFS7 had the highest values; lower values were found at the samples CPP10 and CFS10. So the French fries fried for 10 minutes, in both types of oils, decreased the cohesiveness of the samples (excepting CFS7).

Chewiness. The samples RFS10, RP10 and RP7 had an increased chewiness index, but the lowest value of chewiness was evidenced in CPP10 sample. High values occurred in the round sliced potato shapes, in contrast to the French fries, which indicates that a significant mark can be due to the shape of potatoes.

Physico - chemical analysis

Determination of the dry matter. The analysis was carried out in triplicate. The samples were weighed before and after frying heat treatment, both in sunflower oil and palm oil. For this experiment there were used samples of initial weight (250 g) and then the samples were weighted after frying. For each set of samples, the losses during the thermal treatment were almost the same.

In the figure 7, the RP7 sample registered the greatest loss after heat treatment followed by CPFS7, RPS10 and RFS7. The lowest values were found for samples CPFS7 and RP7. All the samples subjected to frying decreased from the initial weight. The major

influence has been given by 10 minutes of frying, because the samples suffered the largest loss from the original weight.
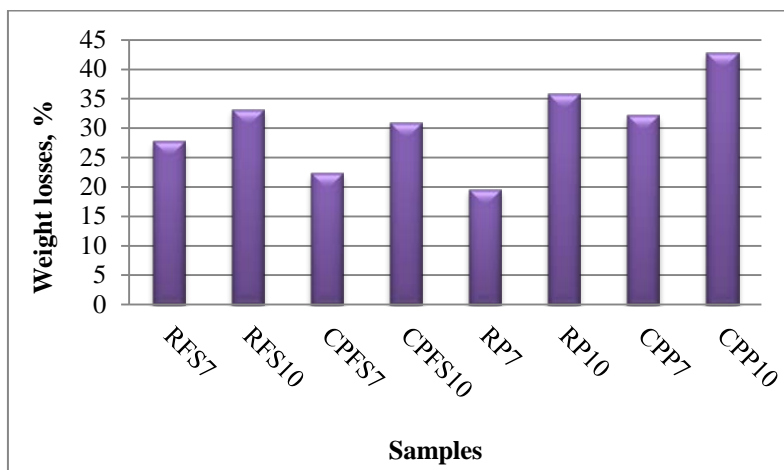

Fig. 7. Percentage of losses due to frying heat treatment (%)

In relation to the type of oils, the samples which lost less weight, were samples fried in sunflower oil, except sample RP7.

Determination of dry matter loss during the thermal treatment. From the figure 8 (The results of dry matter determination) it can be seen that the sample RFS7 had the highest amount of dry matter, followed by samples RFS10 and RP7. The samples of French fries fried in sunflower oil and palm oil have an almost equal quantity of dry matter (CPFS7, CPFS10, CPP7 and CPP10). The lowest value was recorded for the sample RP10.
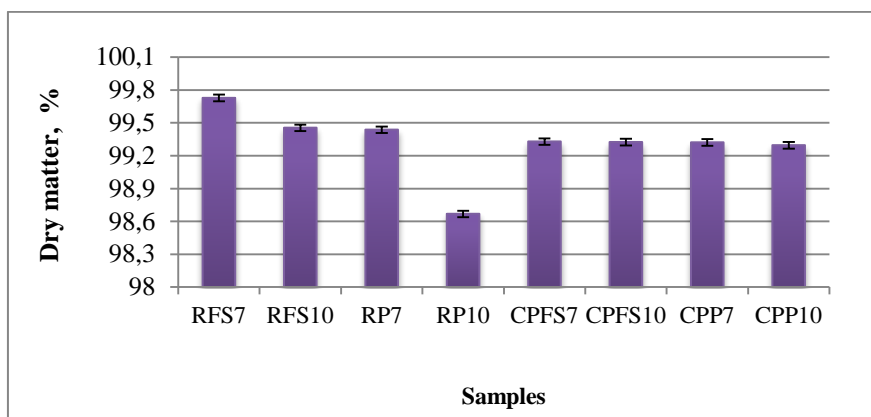

Fig. 8. The results of dry matter determination

CONCLUSIONS

Considering that potatoes are one of the most important crops in the country and the world, being a staple food in the human diet. The potato is a vegetable that satisfy

tastes and different ways to use it, due to its balanced content in carbohydrates, vitamins, fiber and antioxidants.

Therefore, the properties of the potatoes are very important in the production of quality foods, for which in the present study we have treated the changes suffered by the potatoes during the frying heat treatment.

As a general conclusion the fried potatoes properties are influenced by the shape, type of used oil, processing time and also sample's composition.

The panelists appreciated the potatoes samples cut into slices and fried in palm oil for 10 minutes and also the ones cut into slices and fried in sunflower oil for 10 minutes.

Also by textural means the results showed that the potatoes cut into slices and fried into palm oil 7 minutes and in the sunflower oil for 10 minutes had the highest hardness.

As a result, the sample which showed the best textural and sensory characteristics was the one in which the potatoes were cut into slices and fried for 10 minutes in palm oil.

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