THE INFLUENCE OF BLANCHING SOLUTIONS ON SOME FRENCH FRIES SENSORY PROPERTIES

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Introduction

In Lithuania, as well as in all over the world, the increasing attention is paid to food safety and improvement of human nutrition. It is mainly the affect of the consumers’ new attitude to food quality and the possibilities of new technologies and a wide range of raw materials possible for utilization.

Increasing demand for French fries is constantly observed and a high quality assurance is necessary in order to make them a competitive food product. Hence, the following points are of the primary importance: selection of potato cultivars which are characterized by a low level of reducing sugars (not more than 0.25%), suitable blanching of cut potato pieces before frying, reduction of frying temperature and time. If these principles are followed, the final products of the attractive light colour and containing lower amount of acrylamides are possible to obtain [Friedman 1991; Brierley et al. 1996; Finally, Bradshaw 2003; Amrein et al. 2004].

Although the content of dry matter in the products decreases during blanching, the treatment with the use of such factors like vapour, acid or salt solutions can reduce these losses. Some authors [Agbor, Scanlon 1998] investigated the influence of various blanching solutions on the quality of French fries. In the case of 1% ascorbic acid solution the positive changes of the consistence, colour and taste of French fries are observed, and after blanching in 0.2% glucose solution the products are of lighter colour and absorb less fats than those blanched in water [Lesinska, Leszczynski 1989]. The use of NaCl and CaCl₂ solutions at the concentration 0.2-0.4% gives more crispy and solid fries, and a treatment of raw material with starch solution at 0.5 and 1% concentration results in a lower absorption of fats in the final products [Peksa 1994; Tainer-Czopek et al. 2003].

The aim of the experiment was to investigate the influence of blanching solutions on some sensory features of French fries.

Materials and methods

Three Lithuanian bred potato cultivars Mirta, Vokë and Nida from the seasons of 2001-2003 were chosen for the investigation. The cultivars were of medium early maturation and were characterized by a low level of reducing sugars accumulation. They were grown in cv. Vokë branch of the Lithuanian Institute of Agriculture. Potatoes were cultivated according to the technology accepted in Lithuania.

Analyses of chemical composition of tubers were done in two replications. The average samples of 50 tubers were taken for the investigation. They were washed and
sorted. Half of all tubers were used for chemical analyses, the remaining half for the production of French fries. Chemical composition of potato tubers was determined in fresh mass by standard methods: dry matters - by drying to constant mass, sugars (total and reducing) - by modified Bertrand method [LST 1698:2000], darkening of potato pulp - visually and after comparing to Hansen-Keller scale after 1, 4 and 24 hours [Lišinska 1992].

Potato strips were obtained by cutting with special device and properly washed in cold water, dewatered and blanched for 2 minutes in:
- water (60°C);
- hot solution of ascorbic acid 2% (60°C);
- cold solution of ascorbic acid 2% (20°C);
- starch solution 2% (60°C);
- NaCl solution 2% (60°C).

For the efficiency evaluation the control sample of strips not blanched before frying was prepared.

After blanching and removing the excess moisture from the strip surface, the pieces of potato were fried in the edible oil at the temperature of 180°C for 5-7 min. Ready French fries were cooled and defatted [Lišinska 1992]. After 15 minutes the sensory evaluation of colour, consistence, surface crispness, oiliness and taste was carried out according to 5-point system (1 point - bad, 5 points - very good), (LST ISO 6658:2000).

Statistical evaluation of data was done by STATISTICA module of StatSoft data analysis and management integrated system. The investigation results were evaluated by the dispersion analysis method. The least significant difference at 95% probability level was estimated by Fisher LSD test (P < 0.05), dependency intervals and indices of the least significant difference of factor A (cultivar), factor B (blanching solution) and their interaction [Olsson et al. 2000].

Results and discussions

Dry matter accumulation in tubers is mostly determined by genetic characteristics of the cultivar, while the importance of meteorological conditions and other factors are of less significance [Tainer-Czopek et al. 2003].

As indicated from the mean values of the investigation data the highest amount of dry matter was found in cv. Mirta potatoes, and the least amount (or by 1.61 percent unit less) - in cv. Nida potatoes (Tab. 1).

The accumulation of total sugar in potato tubers is considered to be most dependent on genetic characteristics of the cultivar [Sawicka 2003]. Total sugars content in potato tubers for French fries production should not exceed 1% [Rodriguez-Saona et al. 1997]. According to the data obtained during the experiment, total sugars content in tubers differed slightly depending on the cultivar: the essentially highest amount was found in cv. Nida potatoes - 0.45%, and the least - in cv. Mirta potatoes - 0.41% (Tab. 1).

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Dry Matter (%)</th>
<th>Total Sugar (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mirta</td>
<td>1.61</td>
<td>0.41</td>
</tr>
<tr>
<td>Nida</td>
<td>1.61</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Table 1; Tabela 1

Chemical composition of potato tubers
Skład chemiczny bulw ziemniaka
The content of reducing sugars in potato tubers is a highly important component of raw material, determining the colour and taste of French fries. Scientists all over the world proved that in the case of French fries production the desirable amount of reducing sugars should not be higher than 0.5% [JASWAL 1999; FINALY, BRADSHAW 2003; LISINSKA 1994]. The investigation data shows that all tested cultivars accumulated similar quantities of reducing sugars and these did not exceed the set requirements (Tab. 1).

The colour of French fries is one of the most important features of their quality. It can be stated on the basis of the averaged investigation data that French fries made from cv. Nida potatoes were of the lightest and the most attractive colour, while those made from tubers of cv. Vokë potatoes were dark and unappetizing (P < 0.05). None of the blanching solutions used improved this property of French fries significantly, but an inverse result was observed - all solutions, except the hot solution of ascorbic acid 2% (P > 0.05), had a strong colour deepening impact (Fig. 1).

The quality features of potato for French fries changed depending on the blanching solutions used [AGBLOR, SCANLON 1998]. The investigation data shows that the colour intensity of French fries was affected by such factors as the amount of reducing sugars in tubers and the composition of blanching solution. Reducing sugars are not the only index affecting the colour of the obtained final products. It can also depended on some
amino acids, polysaccharides, proteins, etc. [AMREIN et al. 2004]. The statistical analysis of experimental data and the results of the correlation analysis show that the amount of reducing sugars in raw material can impair the colour of French fries by 12-18%. The colour of French fries made from the studied raw material, blanched in starch solution of 2%, was darker by 45% in comparison to control and was estimated by the lowest quantity of points in the sensory evaluation.

The significantly best texture was found in French fries made from cv. Mirta potatoes, particularly those blanched in 2% NaCl solution. Generally, blanching did not improve this index. The majority of solutions used worsened the consistence of French fries, and starch solution of 2% in particular. They usually caused the softening of the produced French fries (Fig. 2). The quantity of dry matter in tubers usually determined the French fries consistence. However, too high content of dry matter makes the consistence of French fries worse - by making them harder [POXOPOB 1985]. This quality index of French fries obtained during the experiment met the set requirements. It was the positive statistical relation of weak significance (r = 0.404) between the amount of dry matter in potato tubers and the consistence of French fries. Blanching can weaken the hardness of the product alongside with lower turgor pressure, the cellular structure changes and a product becomes softer [ALVAREZ et al. 2000]. This is consistent with the data obtained in this experiment. None of the solution used effectively improved the consistence of French fries - in some cases an inverse result was obtained.

![Fig. 2. Sensory evaluation of French fries consistence (in points)](image-url)

Fig. 2. Sensory evaluation of French fries consistence (in points)
Rys. 2.Ocena sensoryczna konsystencji frytek (w punktach)

In the evaluation of the surface crispness, French fries produced from cv. Vokë potatoes were estimated by the lowest quantity of points. The evaluation of the role of solutions shows that blanching of raw material in the hot solution of ascorbic acid of 2% is the only variant when the positive significant effect can be received (P < 0.05), (Fig. 3). According to the Polish scientists LISIŃSKA and LESZCZYNIEWSKI [1989], hardness and crispness of French fries increase in the case when NaCl solution is used for blanching. However, in this study the analysis of the influence of the type of blanching solution on the crispness of French fries shows that immersing in hot water and in starch solution of
2% makes the crispness significantly worse. Probably, after the process of blanching the outer layers of strips having the strongest contact with heat contained free starch turned to jelly but the inner cells of French fries could be filled with swollen granules of starch, which determined a lower skin crispness of the product [AGBLOR, SCANLON 1998].

The crispness of French fries also depends on the dry matter content in raw material [AGBLOR, SCANLON 1998]. Calculation of the dependency of the surface crispness as the effect of dry matter content established statistically significant positive weak correlation (r = 0.453). ALVAREZ et al. [2000] stated that a short blanching of raw material in high temperature resulted in better crispness of French fries than blanching for the longer time in low temperature. In such conditions, blanching activates the enzyme pectinesterase, which influences the hardness alongside with the decomposition of protopectines cellular walls which loose their integrity [ALVAREZ et al. 2000]. These statements in part coincided with the data of the present investigation. The obtained results show that blanching in hot solution of ascorbic acid of 2% improves the surface crispness of French fries by 58.7%, in cold solution of ascorbic acid of 2% - by 24.8%.

French fries produced from cv. Vokë potatoes were estimated as the most greasy and oily by sensory panel, while those made from cv. Mirta potatoes - as the least oil containing. Blanching of potato strips in starch solution produced the most positive effect in the opposite to blanching in NaCl solution and in water. As indicates from the experimental data obtained, the highest estimation in the sensory evaluation with regard to oiliness of French fries received products made from the raw material blanched in starch solution of 2% (P < 0.05), (Fig. 4). It was probably because of starchy coat formed on the surface of the product and it impeding of fats diffusion into inner layers [LISIŃSKA, LESZCZYNSKI 1989].
French fries made from cv. Mirta potatoes had an unpleasant taste of burnt fat. Therefore, they received the lowest quantity of points in a taste evaluation (P < 0.05). The highest quantity of points in taste estimation obtained French fries produced from tubers of cv. Voké potatoes. It was found that fat was not the most important factor influencing the taste of French fries (Fig. 5).

Too high content of total sugar makes the taste of French fries worse [LOVEDEEP et al. 2002]. The statistical analysis allowed to state that the taste of French fries depends on total sugars content in tubers, irrespectively the type of blanching solution.
Statistically important negative medium strong correlation ($r = -0.621$) was established for this relation.

**Conclusions**

1. The sensory properties of French fries depended on the type of blanching solution used as well as on the cultivar of potato.
2. French fries, made from cv. Nida potatoes, were of the lightest and most attractive colour however, blanching in 2% starch solution darkened their colour.
3. The solutions of ascorbic acid, particularly used in high temperature improved the surface crispness of French fries. Other blanching solutions, like 2% starch solution in particular, made French fries texture and surface crispness worse.
4. Blanching of potato strips in 2% NaCl solution made the consistence of French fries better and crispier on the surface, particularly when cv. Mirta potatoes were used, however, the obtained products were characterized by too high oiliness.
5. French fries made from strips blanched in 2% starch solution were of the lowest oiliness.
6. French fries made from tubers of cv. Vokë potatoes were of the best taste.

**Literature**


Key words: French fries, blanching, sensory properties

Summary

The effectiveness of different blanching solutions upon French fries quality features was studied. Three Lithuanian bread potato cultivars Mirta, Vokė and Nida, cultivated in the experimental station of Vokė Branch (Lithuanian Institute of Agriculture) in 2001-2003 were chosen for the investigation. Chemical composition of potato tubers was determined in fresh mass by standard methods. Potato strips were blanched in the following solutions: 2% ascorbic acid in 60°C, 2% ascorbic acid in 20°C, 2% starch solution in 60°C, 2% NaCl solution in 60°C. The strips of potato were fried in the temperature of 180°C for 5-7 minutes in the edible oil. After 15 minutes the sensory evaluation of colour, texture, surface crispness, oiliness and the taste was carried on according to 5-point scale.

The sensory properties of French fries depended on the type of blanching solution used as well as on the potato cultivar. French fries, made from potatoes of cv. Nida, were of the lightest and most attractive colour. Blanching in 2% starch solution darkened French fries colour and made their consistence and surface crispness worse but lowered their oiliness. The solutions of ascorbic acid, particularly used at the high temperature improved the surface crispness of French fries. Blanching of potato strips in 2% NaCl solution was profitable in regard to the consistence of French fries and surface crispness, particularly when cv. Mirta potatoes were used. However, the obtained products were characterized by too high oiliness. French fries made from tubers of cv. Vokė potatoes were of the best taste.
THE INFLUENCE OF BLANCHING SOLUTIONS ...

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Słowa kluczowe: frytki, blanszowanie, cechy organoleptyczne

Streszczenie

Metodą sensoryczną badano wpływ blanszowania słupków ziemniaka w różnych roztworach na właściwości usmażonych z nich frytek. Do badań użyto trzy litewskie, konsumpcyjne odmiany ziemniaka: Mirta, Vokė i Nida uprawiane w latach 2001-2003 na terenie stacji doświadczalnej Litewskiego Instytutu Rolniczego. Określono skład chemiczny bulb metodami standardowymi. Słupki ziemniaka blanszowano w następujących roztworach: 2% kwas askorbinowy o temperaturze 60°C, 2% kwas askorbinowy o temperaturze 20°C, 2% roztwór skrobi o temperaturze 60°C, 2% roztwór NaCl o temperaturze 60°C. Blanszowane słupki smażono w oleju podgrzewanym do temperatury 180°C przez 5-7 minut. Po upływie 15 minut od usmażenia oceniano sensorycznie barwę frytek, ich konsystencję, kruchość warstwy zewnętrznej, oleistość oraz smak według 5-punktowej skali ocen.

Cechy organoleptyczne frytek zależały od rodzaju użytego roztworu blanszującego jak też od odmiany ziemniaka. Frytki otrzymane z bulb odmiany Nida charakteryzowały się najjaśniejszą, najbardziej atrakcyjną barwą. Blanszowanie słupków ziemniaka w 2% roztworze skrobi wpływało na ukształtowanie się barwy ciemniejszej niż pozostałych prób, pogorszenie konsystencji i chrupkości warstwy zewnętrznej, ale obniżało oleistość frytek. Roztwory kwasu askorbinowego, szczególnie stosowane w wyższej temperaturze poprawiły chrupkość warstwy zewnętrznej frytek. Użycie 2% roztworu NaCl do blanszowania okazało się korzystne ze względu na konsystencję frytek i chrupkość ich warstwy zewnętrznej szczególnie, gdy użyto bulb odmiany Mirta. Jednakże otrzymane produkty były zbyt oleiste. Frytki wyprodukowane z bulb odmiany Vokė charakteryzowały się najlepszym smakiem.

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