«Polynomial regression as a tool for prediction quality of bread baked of wheat flour mixed with flour of cereal extrudates»

M. A. Yanova, E. N. Oleynikova and S. V. Khizhnyak
Problem statement

• Extrusion of foods is an emerging technology for the food industries. One of the popular applications of extrusion technology is processing cereal and legume grains for producing grain-based food. Addition of extrudates significantly affects the flour chemical composition and bread quality.

• The objective of the present research was to develop regression models for prediction quality of bread baked from wheat flour mixed with cereal extrudates on the base of chemical composition of flour blends.
Solution methods

• Blends of wheat flour and flours of six types of cereal extrudates (wheat extrudate, wheat extrudate added with Fe, covered barley extrudate, naked barley extrudate, covered oat extrudate and naked oat extrudate) in different proportions were used for bread baking.

• After baking the following quality characteristics of bread were analyzed: titratable acidity, porosity and humidity.

• Statistical analysis was performed with Stat Soft STATISTICA Version 6.0 statistic software package.

• Two types of regression models were used for estimating the relationships between bread quality and chemical composition of flour blends.
Conclusions

Comparison of Multiple regression models and Multivariate polynomial regression models.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Multiple regression</th>
<th>Multivariate polynomial regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>R²</td>
<td>R</td>
</tr>
<tr>
<td>Titratable acidity</td>
<td>0.648</td>
<td>0.805</td>
</tr>
<tr>
<td>Porosity</td>
<td>0.786</td>
<td>0.886</td>
</tr>
<tr>
<td>Humidity</td>
<td>0.334</td>
<td>0.578</td>
</tr>
</tbody>
</table>

• Multivariate polynomial regression models were found to be highly effective tool for prediction titratable acidity ($R^2=0.957$, $p<0.001$) and porosity ($R^2=0.963$, $p<0.001$), and less effective for prediction humidity of bread ($R^2=0.680$, $p<0.01$).

• Deviation of predicted values of titratable acidity from observed values did not exceed 4.0% of actual value and deviation of predicted values of porosity from observed values did not exceed 0.55% of actual values. The accuracy of models did not depend on the type of extrudate and on the proportion of extrudate in flour.

• Using polynomial regression models two VBA applications for prediction and modeling of titratable acidity and porosity of bread baked from random blends of wheat flour and flour of cereal extrudates were developed.
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