Project Flour Plus

The extensive amount of data required for the production of baked goods shall be gathered and connected via a network using methods of Artificial Intelligence to improve product quality.

Flour Plus is a three-year research project that is coordinated by the International Association of Plant Bakers AIBI in Brussels and supported by the European Union with approx. 1.3 million euros. It deals with the question, how baking companies can handle the fluctuating characteristics of flour. This is not a new issue; however Flour Plus examines and addresses it in a new way. Special features of the project include: (1) the European dimension, with integration of numerous baking companies through their associations (2) the detailed consideration of production processes at different scales, from small- and medium-sized businesses (SME) to industrial companies (3), the collection of sensory data to optimize product characteristics in a way that they get the highest acceptance from the consumers (4) the usage of Artificial Intelligence as new method of data analysis and modelling. „Our B2B-customers cherish have expectations on quality. Colour, volume and dimensions of baking goods are specified within narrow tolerances. Every day, we have to cope with the problem that baked goods do not meet these criteria and cannot be sold," explained a participant of the Flour Plus Workshops at the beginning of 2014 and with this, he got to the point of the main motivation for the project. „In case of deviating baking results, we check all our process parameters at first. If they are ok, we search for the reason in the area of the raw materials – especially for flour."

Vision

The vision behind Flour Plus is: A correlation model that connects analytic flour data, process parameters, baked good features and customer perception. With this, it shall be possible to adapt the process parameters in a flexible way when the flour characteristics fluctuate, so that always the best possible backing result

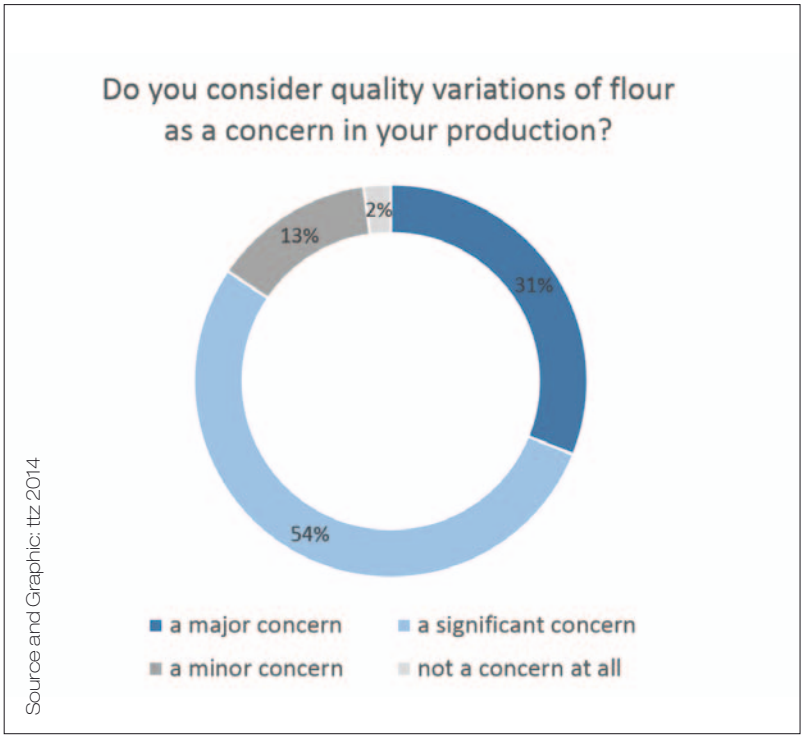

Fig. 1 – Results received from the Flour Plus survey, in spring 2014.

will be achieved. The finding that flour have characteristics partially fluctuate should not be understood as reproach against the milling industry. Millers already do a lot of work to standardize the flour types, especially by targeted mixing of selected crop batches. It is up to the baking companies to deal with the natural residual variations as well as possible.

Current situation

As a first step in the project, the current situation in European companies was investigated. For this purpose, workshops were held in Paris, Madrid, and Düsseldorf in spring 2014, in which representatives of SME and industrial businesses took part. These workshops were organized by the national associations of France (FEB), Spain (Asemac) and Germany (VDG) and moderated by ttz Bremerhaven. In addition, an online survey was completed in which 47 companies from twelve countries took part. These consultations confirmed the relevance of the project's topic. As 85 percent of the companies stated that they consider quality fluctuations of flour as a problem in their production (Fig. 1) Moreover, 63 percent of the companies consider that quality fluctuations of their final products are caused by quality fluctuations of flour. In the discussions, it became clear that nearly all companies use a fixed recipes and fixed process parameters for each of their final products. A flexible adaptation of the production conditions depending on the raw material characteristics is not planned in the standard procedures. Only when the baking result does not meet

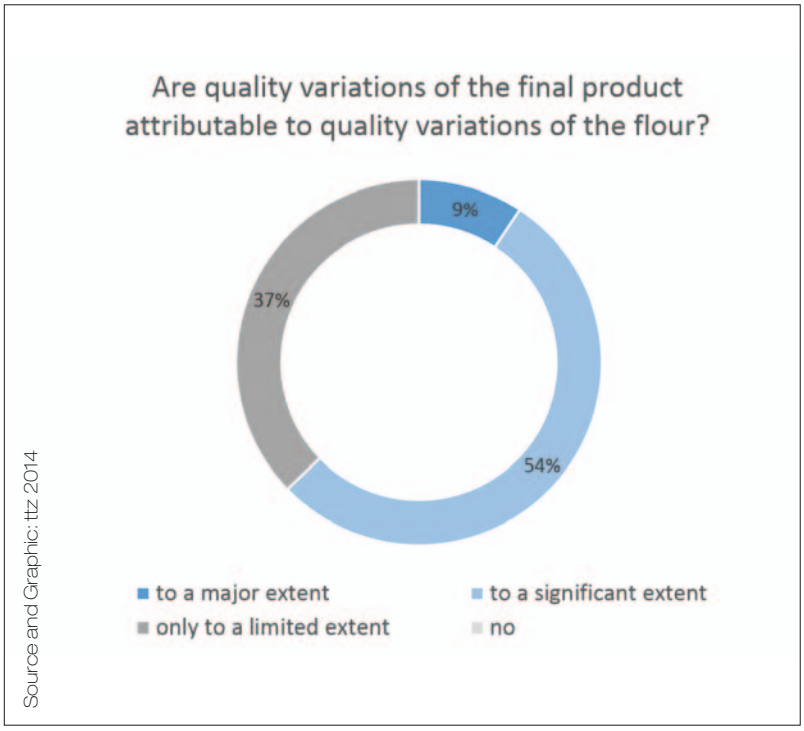

Fig. 1 – Results received from the Flour Plus survey, in spring 2014.

Photos: [1,2] ttz 2014

[1] In Cork, Ireland, UCC currently investigates the influence of different yeast strains and different fermentation regimes on the properties of toast bread. [2] In Bremerhaven, ttz currently performs flour analyses and baking trials with about 40 different European wheat flours. Both direct fermentation and fermentation interruption are being considered.

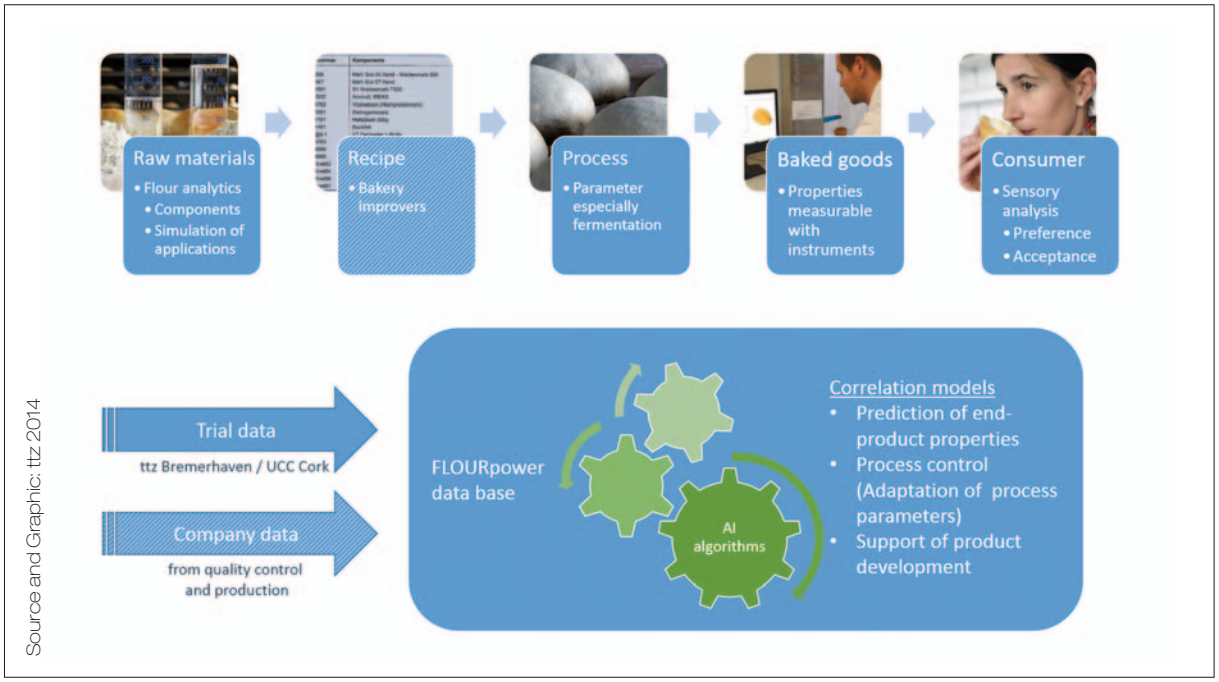

Fig. 2 – Schematic diagram of the data basis and the evaluation mechanisms of the Flour Plus-System. The hatched blocks display the possibilities for further system development after the project has been finished.

the expectations, the production conditions will be adapted. This is mostly not done in a systematic way and supported by data but empirically, often under high time pressure, and on the basis of their employees' experience. Therefore, the implementation of the project vision requires rethinking of rigid production conditions to obtain flexible ones. The consultations with the companies displayed a high, general openness of the bakery business for this change. In addition, our survey allowed the development of a complex image and finding out differences that depend on the business models of the companies or their geographic markets. It became clear that the topic of rejected goods has a higher relevance in the B2B business because there, clear exclusion criteria are specified for the baked goods in the contracts. In addition, in the direct business with the final customers (consumers), fluctuations of final product quality are more probably accepted. Furthermore, industrial plants with mono-lines have more possibilities to collect data of raw material, processes and products and to control their processes based on data gathered. A challenge of the

Many different parameters can be measured on flour. However, how can we use the measured data to control the production process? Artificial Intelligence shall deliver the answer on this question.

Flour Plus project is it to deliver IT tools in a form that allows their applications also in medium-sized businesses.

Strategy

The heart of the project consists of it experimental works that are currently taking place at the ttz Bremerhaven and the UCC Cork at the moment. These works provide data to the initial Flour Plus data base. This data base is being processed with Artificial Intelligence algorithms at TZI (University of Bremen) to develop the first correlation models. Moreover, a user interface is being developed there that will enable the companies and the associations to interact with the Flour Plus system. Obviously, only a limited number of flour types, recipes, and process conditions can be investigated in the project. For instance, the influence of baking agents is not examined. However, the system is designed in a way that companies will have the possibility to feed it with their own QS and production data later thus dramatically improving the validity of the calculations for their production. Models are being developed that show how, on the one hand, the companies will be able to protect their sensitive data and, on the other hand, to share some meta data with other users to increase the quality of the system as a whole.

Flour analysis

The Flour Plus team examines a pool of approx. 40 European flours. Each flour is analysed with approx. 20 methods that mirror the variety of methods used in Europe. Some methods quantify the chemical components of flour; other ones examine their functionality by simulating certain aspects of the application. In addition to already established methods, among others, also the Solvent Retention Capacity (SRC) und die Particle Charge Detection (PCD) are used in the project to explore and characterize the flour. The data analysis shall show how analytic data sets correlate with

[1] A total of 6000 consumers will perform the sensory evaluation of rolls and toast in the Flour Plus project at the ttz Bremerhaven. [2] Toast bread and rolls are the model products in focus of the FLOURplus project.

each other as well as with the data sets from the baked goods characterization and from the sensory evaluation.

Sensory

The sensory impressions, when eating baked goods, are complex and multi-modal, because all sensory organs are involved. When biting into a roll or a slice of bread, the textural impressions (hard, tough, crunchy, soft), aromatic impressions (salty, sweet, malty) as well as the auditory evaluation (cracking, crunchy) are imparted and influence the total impression of the baked goods. The total impression is strongly influenced by the impression of freshness. It is the most important criterion for the consumer. The examinations of the sensory characteristics in the Flour Plus project include the measurement of sensory characteristics of the selected types of bread and roll using of objective, as well as subjective methods. The project team measures the freshness or fresh-keeping by combined tests that include flavour analysis, sensory profiling and testing for differences. The consumers' expectations on food are mainly affected by the socio-cultural environment. This is why the sensory examinations in Flour Plus are executed in different European countries. Hence, what tastes good for a German person, might be anathema to an Irish one, and vice versa.

Artificial Intelligence

In the Project Flour Plus, TZI uses the methods of Artificial Intelligence in the field of food production for the first time.

Project Flour Plus

Intelligent and easy tool to categorise and characterise flour quality for consumer-driven wheat baked goods in European SME-bakery and cereal sector.

Duration:	Feb. 2014 – Jan. 2017
Project partner:	AIBI, Asemac, VDG, FEB, Backhaus Häussler, ttz Bremerhaven, TZI at the Uni Bremen, University College Cork
Subsidies:	1.3 million euros from the European Research Programme FP7 – Research for SME associations

www.flourpowerproject.eu

FLOURPLUS

Authors

Julien Huen, Imke Matullat, Linda Ringer, Prof. Klaus Lösche, ttz Bremerhaven
Prof. Stefan Edelkamp, Prof. Michael Lawo, TZI - University of Bremen

Toast bread and rolls are the model products in focus of the FLOURplus project.

The basis of the procedure of Artificial Intelligence is the recognition of patterns in data sets. Knowledge obtained in the past is processed to achieve improvements through concrete instructions for the future. Already in various projects with industrial partners, the researchers demonstrated that they are able to develop practical solutions for complex tasks with large amounts of data. To be able to successfully transfer Artificial Intelligence from former classical fields of application, e.g. robotic and logistics, into the baking industry, the scientists of TZI have used the consultations with the representatives of the industrial segments to determine the specific demands of the baking companies. As a result, they have formulated precisely the future functionalities and application scenarios of the Flour Plus system in form of a system specification in a technical language.

Prospect

The Flour Plus project is a chance to address the problem of quality fluctuations of flour in a profound and holistic way. Modern information technology provides innovative possibilities for data collection and analysis. Especially, large amounts of data can be gathered automatically and processed to generate recommendations for process optimizations. However these possibilities should never be seen as a substitute but always support the employees' Know-How. Also in future, production should be controlled by people and not by machines. Finally, the project is an important discussion platform within the industrial segment that is used by many companies to exchange their experiences.

IMPRINT

VOLUME NO. 13

Backtechnik international

est. 2002

Publishing house: (place of company) INGER Verlagsgesellschaft mbH, Luisenstraße 34 (ehem. 1a), 49074 Osnabrück
Postfach 1220, 49002 Osnabrück, Head office: +49 541 580544-30

Editor/ Publisher/ Managing Director: Trond Patzphal, Telefon: +49 541 580544-57, Telefax: 0541 580544-98, E-mail: patzphal@ingerverlag.de

Publishing director/ Editor-in-chief: Dirk Waclawek (wac) V.i.S.d.P., Telefon: +49 541 580544-51, Telefax: +49 541 580544-99, E-mail: waclawek@ingerverlag.de

Editorial office: Luisenstraße 34 (ehem. 1a), 49074 Osnabrück, Fax: +49 541 580544-99, E-mail: redaktion.backtechnik@ingerverlag.de

Editors: Gregor Vogelpohl (gv), Tel.: +49 541 580544-45, E-mail: vogelpohl@ingerverlag.de
Erich Meyer (eme), Tel.: +49 541 580544-55, E-.ail: meyer@ingerverlag.de
Marcel Schneider (ms), Tel.: +49 541 580544-56, E-mail: schneider@ingerverlag.de
Elke Moorman (elmo), Tel.: +49 541 580544-35, E-Mail: moormann@ingerverlag.de

Graphics: Antonia Bartholomäus, Tel.: +49 541 580544-40, E-mail: bartholomaeus@ingerverlag.de
Julia Stele, Tel.: +49 541 580544-41, E-mail: stele@ingerverlag.de
Silvi Harri, Tel.: +49 541 580544-67, E-mail: harri@ingerverlag.de

Website: www.ingerverlag.de

Advertisements: Advertisement price list 13 dated 1st January 2014
The publishing house is not respon sible for accuracy in the case of advertisements ordered by telephone.

Publishing director: Sonja Shirley, Tel.: +49 234 915271-76
Advertising sales: E-mail: shirley@ingerverlag.de

Advertisement management: Volker Kohl, Tel.: +49 234 915271-16, Fax: +49 234 915271-19, E-mail: kohl@ingerverlag.de

Subscription - service: INGER Verlagsservice, Föhrster Str. 8, 31061 Alfeld, Tel.: +49 5181 8004-40, Fax: +49 5181 8004-81, E-mail: abo@ingerverlag.de

Printers: Silber Druck oHG, Am Waldstrauch 1, 34266 Niestetal

Subscription prices: Backtechnik international (2 issues a year) at the domestic annual subscription price of 35 euros (subscription fee 25 euros incl. VAT plus domestic postage 10 euros incl. VAT, postage abroad 20 euros incl. VAT, same annual subscription rate). In addition to the print subscription, subscribers can order a digital subsciption. The digitial subscription costs are 10 euros incl. VAT for subscribers and 25 euros incl. VAT for non subscribers. Subscription cancellations must be sent in writing to the publishing house two months before the end of the subscription year. In the event that the magazine is not published due to force majeure, a shortage of materials, a strike or similar, there shall be no claim for subsequent delivery or damages.

Journal reference number: 58225

ISSN: 1860-7799

Supplements: none

Cover photo: INGER Verlagsgesellschaft

Place of jurisdiction: Place of jurisdiction is Osnabrück.

The **General Terms and Conditions** of INGER Verlagsgesellschaft mbH, which can be viewed on the internet at **www.ingerverlag.de** apply.

An entity of INGER Verlagsgesellschaft mbH