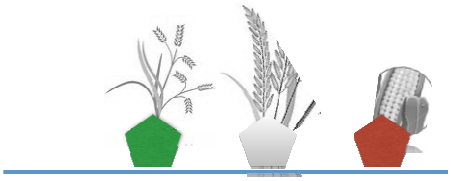
UNIVERSITÀ DEGLI STUDI DI MILANO

15th EYCSTW



15th European Young Cereal Scientists and Technologists Workshop

April 26th-29th, 2016
Bergamo, Italy
Centro Congressi "Giovanni XXIII"

CENTRO CONGRESSI
GIOVANNI XXIII

GOLDEN SPONSOR

AB MAURI

VALDIGRANO

Mais Spinato di Gandino

CSM Bakery Solutions

SILVER SPONSORS

GoodMills Innovation

DUPONT

CHOPIN TECHNOLOGIES

MOLINO QUAGLIA

BÖCKER The experts in sourdough

WELCOME MESSAGE

On behalf of the whole Organizing Committee, we are delighted to welcome all of you to Bergamo for the 15th European Young Cereal Scientists and Technologists Workshop. This is a rotating event, changing location and organizers every year, that will give participants a platform to exchange ideas, discover novel opportunities, reacquaint with colleagues, meet new friends, and broaden their knowledge. Although the Conference is nominally associated with DeFENS at the University of Milan, the largest and oldest food-related Department in Italy, our meeting is being held in Bergamo, which is both convenient and spectacular, as you will experiment in person.

Indeed, aside from highlighting scientific interactions and collaborations and from offering occasions for exchanging ideas in a relaxed setting, you will be given occasions to enjoy the unique location, culture and geography of the place. As you may see from the program, scientific sessions will be intertwined with visits to local business, and to places where traditional food is kept alive. We hope all of these - and what you will discover by yourself in whatever free time you may shave from the schedule - will be as enjoyable as the scientific sessions themselves.

Along the lines of these meetings, we have tried to include in the program contributions from both experienced speakers and from those of you that are willing to take the podium and share your experience. DeFENS has a solid tradition of excellent research in this field, and has joined forces within its faculty and staff to make further progress in some novel aspects of cereal-related research. We all hope that this occasion will further consolidate this trend, and look forward to your constructive criticism and feedback. This will be essential for further improvement of what represents a quite unique initiative, at least at the European level.

The DeFENS team

LIST OF PARTICIPANTS

	SURNAME	FIRST NAME	E-MAIL	COUNTRY
1	Abbasi Parizad	Parisa	parisa.abbasi@unimi.it	Italy
2	Alfieri	Michela	michela.alfieri@entecra.it	Italy
3	Bay	Betül	btlby@hotmail.com	Turkey
4	Bellocq	Bettina	bettina.bellocq@supagro.inra.fr	France
5	Bilgili	Sultan Damla	sdbilgili@hotmail.com	Turkey
6	Brandner	Silvia	silvia.brandner@tum.de	Germany
7	Brøgger	Anja	stxafbr@nottingham.ac.uk	UK
8	Cardone	Gaetano	gaetano.cardone@unimi.it	Italy
9	De Brier	Niels	niels.debrier@biw.kuleuven.be	Belgium
10	Diallo	Aboubakry	a.diallo@hw.ac.uk	UK
11	Elgeti	Dana	dana.elgeti@tum.de	Germany
12	Gally	Timothée	timothee.gally@oniris-nantes.fr	France
13	Giordano	Debora	debora.giordano@unito.it	Italy
14	Gökşen	Gülden	gulgok33@gmail.com	Turkey
15	Heitmann	Mareile	m.heitmann@umail.ucc.ie	Ireland
16	Henrich	Alexander	alexander.henrich@csmbakerysolutions.com	Germany
17	Hesso	Nesrin	nesrin.hesso@oniris-nantes.fr	France
18	Jakobi	Sabina	sabina.jakobi@tum.de	Germany
19	Jeske	Stephanie	stephanie.jeske@umail.ucc.ie	Ireland
20	Joubert	Marianne	marianne.joubert@supagro.fr	France
21	Juvonen	Minna	minna.juvonen@helsinki.fi	Finland
22	Karp	Sabina	sabina_karp@sggw.pl	Poland
23	Kurek	Marcin	marcin_kurek@sggw.pl	Poland
24	Langó	Bernadett	bernadett.lango@mail.bme.hu	Hungary
25	Laukemper	Rita	rita.laukemper@tum.de	Germany
26	Lexhaller	Barbara	barbara.lexhaller@lrz.tum.de	Germany
27	Marengo	Mauro	mauro.marengo@unimi.it	Italy
28	Martínez Mancebo	Camino	caminommancebo@gmail.com	Spain
29	Masure	Hanne	hanne.masure@biw.kuleuven.be	Belgium
30	Melis	Sara	sara.melis@biw.kuleuven.be	Belgium

31 Németh	Renáta	nemeth.renata90@gmail.com	Hungary
32 Nicolodi	Anja	anja.nicolodi@students.boku.ac.at	Austria
33 Öztop	Kamuran	kamuran.oztop@toros.edu.tr	Turkey
34 Pasha	Imran	ipasha2001@uaf.edu.pk	Pakistan
35 Perez-Quirce	Sandra	sperez@iaf.uva.es	Spain
36 Pico	Joana	joana.pico@uva.es	Spain
37 Román	Laura	laura.roman@iaf.uva.es	Spain
38 Sahin	Aylin	a.sahin@umail.ucc.ie	Ireland
39 Serin	Seher	sserinkarayiyen@gmail.com	Turkey
40 Sutcliffe	Charles	charles.sutcliffe@abmauri.com	Netherlands
41 Van der Maelen	Eva	eva.vandermaelen@biw.kuleuven.be	Belgium
42 Van Oort	Marteen	maarten.vanoort@abmauri.com	Netherlands
43 Verbauwhede	Annelien	annelien.verbauwhede@biw.kuleuven.be	Belgium
44 Villanueva	Marina	mvillanueva@iaf.uva.es	Spain
45 Vogel	Claudia	claudia.vogel@lrz.tum.de	Germany
46 Xu	Yan	xu.z.yan@helsinki.fi	Finland
47 Weegels	Peter	p.weegels@sonneveld.com	Netherlands
48 Wium	Helle	helle.wium@dupont.com	Denmark
49 Zanoletti	Miriam	miriam.zanoletti@unimi.it	Italy

WORKSHOP PROGRAM

Tuesday, April 26th 2016 at Centro Congressi "Giovanni XXIII" Entrance Hall	
16:00-20:00	Registration
18:00-19:30	"Meet and Greet" (welcome reception and buffet) at Centro Congressi "Giovanni XXIII" Entrance Hall

Wednesday, April 27th at Centro Congressi "Giovanni XXIII"	
Introductions to the 15th EYCSTW	
09:00	**Peter Weegels, Cereals & Europe** **Francesco Bonomi, DeFENS, University of Milan** **Aboubakry Diallo, Cereals & Europe** **Mauro Marengo, DeFENS, University of Milan**
09:30-10:00	**Keynote lecture** **Prof. Francesco Bonomi: The role of macromolecular structure in cereals and cereal-based products**
Session 1: Nutrition & Health **Chair: Stefania Iametti (University of Milan)**	
10:00-10:15	**Barbara Lexhaller**: Pathogenesis of celiac disease: Identification of covalent conjugates between tissue transglutaminase and gluten peptides from different cereals
10:15-10:30	**Sabina Karp**: Muffins with cocoa dietary fiber and steviol glycosides as an pro-healthy alternative to chocolate muffins
10:30-10:45	**Stephanie Jeske**: Evaluation of physicochemical and glycemic properties of commercial plant-based milk substitutes
10:45-11:15	**Coffee break & Networking**
11:15-11:30	**Sultan Damla Bilgili**: Advantage of using extrusion technology for the reduction of antinutritional factors in faba bean flour
11:30-11:45	**Marcin Kurek**: Particle size of dietary fiber preparation affects selected vitamin B bioaccessibility in fortified wheat bread
11:45-12:00	**Seher Serin**: The effect of cooking time on starch digestibility characteristics and bile acid binding capacity of pasta
12:00-12:15	**Gülden Göksen**: Nutritional properties of bread substituted with Date seeds powder
12:15-12:30	**Aylin Sahin**: Fundamental studies on the reduction of sugar in burger buns

12:30-12:45	**Michela Alfieri**: Maize inbred lines: nutritional and technological characteristics suitable for food
12:45-14:00	**Lunch @ Centro Congressi "Giovanni XXIII"**
Session 2: Bioactive compounds **Chair: Mauro Marengo (University of Milan)**	
14:00-14:15	**Parisa Abbasi Parizad**: Pigmented grains as a source of immunomodulating bioactives
14:15-14:30	**Debora Giordano**: Phenolic acid and antioxidant activity evolution during kernel development of colored corn grain and relationship with mycotoxin contamination
14:30-14:45	**Imran Pasha**: Antioxidant scenario of value added bread supplemented with fenugreek
14:45-15:00	**Sandra Perez-Quirce**: Enrichment of gluten-free doughs and breads with β-glucans extracted from *Pleurotus ostreatus*
15:00-15:15	**Betül Bay**: Incorporation of black carrot pomace powder into bread as an antioxidant
15:15-15:30	**Anja Brøgger**: Impact of sodium chloride on moisture sorption of starches
15:30-15:45	**Refreshments**
Session 3: Enzymes **Chair: Francesco Bonomi (University of Milan)**	
15:45-16:00	**Sara Melis**: A lipase based study of wheat endogenous lipid and puroindoline functionality in bread making with flour from near-isogenic wheat lines
16:00-16:15	**Laura Román**: Functional properties of native maize and extruded flours modified by branching enzyme and maltogenic α-amylase
16:15-16:30	**Annelien Verbauwhede**: Impact of endopeptidase activity during the baking phase in straight dough bread making on gluten network formation and bread crumb texture
16:30-16:45	**Yan Xu**: Exopolysaccharides production during the fermentation of faba bean flour by *Leuconostoc mesenteroides* DSM 20343
16:45	Free time
19:00	**Dinner @ La Marianna (Bergamo Upper Town)**

Thursday, April 28th at Centro Congressi "Giovanni XXIII"	
Session 4: Crop Quality **Chair: Peter Weegels (Chairman C&E)**	
09:00-09:15	**Marianne Joubert**: Impact of durum wheat grain composition on semolina yield and pasta quality
09:15-09:30	**Bernadett Langó**: Carbohydrate composition of Hungarian triticale genotypes
Session 5: Processing **Chair: Peter Weegels (Chairman C&E)**	
09:30-09:45	**Bettina Bellocq**: Description of rolling as unit operation during the couscous process
09:45-10:00	**Niels De Brier**: The potential benefits of wheat pearling prior to milling for producing bran with improved nutritional and technological properties
10:00-10:15	**Timothée Gally**: A comparative study on bread staling when baking with ohmic heating or conventional baking using a Peltier baking module
10:15-10:30	**Rita Laukemper**: Relation between adhesion properties of cereal doughs and microbial contamination of proofing trays - Influence of the surface character
10:30-11:00	**Coffee break & Networking**
11:00-11:15	**Anja Nicolodi**: Baking performances of sprouted wheat flour
11:15-11:30	**Eva Van der Maelen**: Investigation of the fermentation capacity of different *Saccharomyces cerevisiae* strains in bread dough
Session 6: Methods in Cereal Science **Chair: Alessandra Marti (University of Milan)**	
11:30-11:45	**Mareile Heitmann**: Influence of sourdough type and quantity on gluten quality parameters measured by Gluten Peak Tester following a correlation analysis on bread quality parameters
11:45-12:00	**Renáta Németh:** Investigation of the applicability of a micro-scale baking test in wheat quality research
12:00-12:15	**Claudia Vogel**: Development of a LC-MS/MS method to quantify puroindolines in wheat grain
12:15-12:30	**Minna Juvonen**: Structural characterization of cereal-based oligosaccharides by MS/MS

12:30-13:30	**Lunch @ Centro Congressi "Giovanni XXIII"**
13:45	**Trip to "Valdigrano" Pasta-Making Plant in Rovato**
16:30	**Trip to Gandino "Mais Spinato" Community** - Production and milling of this ancient corn variety - Visit to the local museum - Discussion on the topic: "*Product Environmental Footprint in the Agri-Food Productions*" - ***IEFE Bocconi Milano***
20:00	**Dinner @ Locanda "Il Centrale"**

Friday, April 29th at Centro Congressi "Giovanni XXIII"	
09:00-09:30	**<u>Keynote lecture</u>** **Dr. Alessandra Marti: How to replace gluten functionality in gluten-free pasta? Traditional and novel technologies**
Session 7: Gluten-Free Foods **Chair: Mauro Marengo (University of Milan)**	
09:30-09:45	**Hanne Masure**: The role of buckwheat flour in the quality determination of gluten-free starch bread
09:45-10:00	**Joana Pico**: Aroma profiles of different gluten-free doughs and crumbs
10:00-10:15	**Marina Villanueva:** Applications of Ethiopian tef varieties in formulation of high nutritional profile gluten-free breads
Session 8: Mechanical and Rheological Properties **Chair: Aboubakry Diallo (Cereals & Europe)**	
10:15-10:30	**Silvia Brandner**: Imitation of wheat dough by a synthetic polymer-based medium to investigate gas forming and holding capacity
10:30-10:45	**Nesrin Hesso**: Role of ingredient interactions on structural and physycal characteristics of cake batter
10:45-11:15	**Coffee break & Networking**
11:15-11:30	**Sabina Jakobi**: Influence of mechanical stress on starch structure and functionality
11:30-11:45	**Camino Martínez Mancebo:** Effect of the inclusion of different soluble and insoluble fibres on sugar-snap cookie quality
11:45-12:00	**Miriam Zanoletti**: Including buckwheat bran in wheat dough and bread: what happens?

Session 9: Product Reformulation Chair: Alessandra Marti (University of Milan)	
12:00-12:15	**Kamuran Öztop**: Production of bakery products added carob (locust bean)
12:15-12:30	**Gaetano Cardone**: Sprouted wheat as an alternative to conventional flour improvers
12:30-13:00	**Final Discussion & Closing Remarks**
13:00	**Lunch @ Centro Congressi "Giovanni XXIII"**

ORAL PRESENTATION ABSTRACTS

The role of macromolecular structure in cereals and cereal-based products

Francesco Bonomi

Section of Chemical and Biomolecular Sciences, Department of Food, Environmental and Nutritional Sciences (DeFENS), University of Milan

francesco.bonomi@unimi.it

There had been times when our understanding of cereal systems flours did not go much beyond a “percent components” list, often integrated by empirical appreciation of performance. Attempts at correlating these two parameters, taking also into account the genetic and agronomic factors that govern each of them, had been laborious and scarcely productive, until proteomics brought substantial improvement in our understanding of the (relevant) proteins present in a given material.

Our group in Milan had been focusing on yet another issue, related to whether the proteins present in a given cereal present the structural features that may be required for a given use. A better understanding of structural issues is required to understand and – to some extent – to drive food processes aimed at appropriately “machining” suitable macromolecular raw materials to achieve a specific goal, be that retaining properly sized bubbles in bread or avoiding “glue stick” spaghetti. In the particular case of cereal-based products, the inherently complexity and heterogeneity of the involved bio-macromolecules, the variety of products and their modest added value, and the money/energy driven requirement for using simple technology during transformation pose additional major challenges to the food (bio)technologist. Understanding the molecular nature and background of process-related changes, defining the involved molecules, assessing which of their structural features are fitted to the task, and directing the interplay between components and process in response to specific customer needs or to new situations in the industry also is a challenge that needs to be tackled by providing adequate approaches.

A methodological complication stems from the fact that many of the methodological approaches familiar to the biochemist and the biopolymer chemist were not designed for being applied to the insoluble macromolecules that make up most of cereal-based food systems. Thus, novel approaches (or novel twists of established ones) are being developed and tested as for the nature, the quality, and the reliability of the information that can be derived from their application to a number of cereal-based products.

A brief review of some developments in this particular area will be offered here, addressing their potential and their limitations. Focus will be placed on how individual approaches may be combined to address: 1) the molecular determinants of "macromolecular quality" of starting materials; 2) the molecular aspects of process-induced changes in individual macromolecules and of their dependence on the processing conditions; 3) the nature, relevance, and extent of interactions among macromolecules as affected - in various cereals - by various types of processing.

Francesco Bonomi is full professor of Biochemistry at the University of Milan. He has been Department Head at DISMA (2005-2012) and at DeFENS (2012-2014), and has published >170 ISI-indexed papers in fields ranging from process-induced modification of food proteins to nanobiotechnology, and from metal biology to industrial enzymology. He has been or is serving on the Editorial Board of various Journals, and on the Executive Committee of national and international Scientific Societies.

Pathogenesis of Celiac Disease: Identification of Covalent Conjugates Between Tissue Transglutaminase and Gluten Peptides from Different Cereals

Barbara Lexhaller, Peter Koehler, Katharina Scherf

Deutsche Forschungsanstalt für Lebensmittelchemie, Leibniz Institut,
Lise-Meitner-Str. 34, 85354 Freising, Germany

Barbara.Lexhaller@lrz.tum.de

- Key role of tissue transglutaminase (TG2) in the complex pathogenesis of celiac disease
- Characterization of the protein types of wheat, rye, barley, and oats
- Characterization of the enzyme TG2
- Identification of binding sites between TG2 and gluten peptides by LC-MS

Celiac disease (CD) is one of the most frequent food intolerances affecting approximately 1 % of the population. It is characterized by serious damage of the small intestinal mucosa and accompanied by a drastic decrease of nutrient uptake. CD is triggered by the ingestion of storage proteins of wheat, rye, barley, and possibly oats, which have been termed gluten in the field of CD. Due to its high proline content, gluten is incompletely digested by gastrointestinal peptidases leading to long-chain peptides, which pass the enterocyte layer and trigger the immunological response leading to the typical symptoms of CD. The intestinal tissue transglutaminase (TG2) plays a key role in the complex pathogenesis of CD. Firstly, TG2 catalyzes deamidation of specific glutamine residues of gluten peptides and secondly, TG2 forms covalently linked conjugates with gluten peptides, which induce the formation of antibodies against these conjugates. While the specificity of TG2 in the deamidation of glutamine residues has been elucidated, only very limited information is available on the structure and occurrence of TG2-gluten peptide conjugates.

The aim of the research is to identify binding sites between TG2 and gluten peptides of all CD-active protein types. The first important step was the isolation of all CD-active protein types of wheat (ω5-, ω1,2-, α-, γ-gliadins, HMW- and LMW-subunits of glutenin), rye (ω-, γ40k-, HMW- and γ75k- secalins), barley (C-, γ-, D- and B-hordeins) and oats (avenins) by extraction and preparative RP- HPLC as well as the characterization of these protein types by SDS-PAGE, N-terminal sequencing, and liquid chromatography mass-spectrometry (LC-MS) of the intact proteins. The same approach was used for the second important step, the characterization of a microbial transglutaminase.

For the main part of the research, the identification of the binding sites, the isolated proteins will be partially hydrolyzed with gastrointestinal peptidases into CD-active peptides. These peptides will then be incubated with TG2. The conjugates containing isopeptide crosslinks between TG2 and gluten peptides will be partially hydrolyzed again to form peptides of suitable sizes. These isopeptide cross-linked peptides will be identified by means of different LC-MS experiments.

Barbara Lexhaller is a PhD student at the Deutsche Forschungsanstalt für Lebensmittelchemie, Leibniz Institut, Freising. She holds a state examination in Food Chemistry and wrote her final exam thesis about studies on the specificity of ELISA kits for gluten quantitation. Barbara is a member of the Young Food Chemists Association (a section of the German Chemical Society) and also of the student chapter of the American Chemical Society.

Muffins with cocoa dietary fiber and steviol glycosides as a pro-healthy alternative to chocolate muffins

Sabina Karp, Jarosław Wyrwisz, Marcin Kurek, Agnieszka Wierzbicka

Division of Engineering in Nutrition, Faculty of Human Nutrition and Consumer Sciences, Warsaw University of Life Sciences

sabina_karp@sggw.pl

- High content of dietary fiber
- Decreased caloric value
- Pro-healthy alternative to chocolate muffins
- Steviol glycosides as a natural replacement of sucrose

Creation a low-caloric functional product benefits was the solution for overweight, low intake of dietary fiber and high consumption of sweet products, especially among children. As the matrix for the study muffins were chosen.

Chocolate muffins are one of the products which have negative impact on health due to its high fat and carbohydrates content. Application of cocoa fiber powder seems to be one of the possible solutions for calorie value reduction as replacement for cocoa powder. Sugar normally used in muffins could be replaced with steviol glycosides This noncaloric natural sweetener is approximately 250-300 sweeter then sucrose. The aim of this study was to develop the muffins with pro-health benefits which could become the natural alternative to chocolate ones.

Methodology used in the study consisted of physical (texture, colour, porosity, microstructure), chemical (Total Dietary Fiber (TDF), Total Phenolic Content (TPC)) and sensory analyses.

The observed results reviled that the addition of cocoa dietary fiber caused the increase of firmness, porosity and both TDF and TPC content. The decrease of L* value due to addition of cocoa DF results in comparable lightness to chocolate muffins. Sensory analyses proved that produced muffins with cocoa and steviol glycosides did not affect the quality.

The conducted research exhibited that the cocoa DF and steviol glycosides addition could be perceived as applicable technology for producing pro-healthy muffins

Sabina Karp is a Research Assistant in the Division of Engineering in Nutrition, Faculty of Human Nutrition and Consumer Sciences at Warsaw University of Life Sciences. Moreover, she is a first-year PhD student at the same Faculty. Her main research interests are physicochemical analysis of cereal products. She is also concentrated on effect of bioactive substances addition on technological properties of confectionary products such as muffin, buns or sponge cake. She is interested in technological properties and structure of the dietary fiber.

Evaluation of physicochemical and glycemic properties of commercial plant-based milk substitutes

Stephanie Jeske, Emanuele Zannini, Elke K. Arendt

School of Food and Nutritional Sciences, University College Cork, Cork, Ireland

Stephanie.Jeske@umail.ucc.ie

- The market for plant-based dairy-type products is growing
- Plant-based milks have higher glycemic indices than cow's milk
- Most plant-based milks are highly unstable dispersions
- Most commercial plant-based milks do not match the nutritional quality of cow's milk

The market for plant-based dairy-type products is growing as consumers replace bovine milk in their diet, for medical reasons (e.g. lactose intolerance, cow's milk allergy) or as a lifestyle choice.

A screening of 17 different commercial plant-based milk substitutes based on different cereals, nuts and legumes was performed, including evaluations of physicochemical and glycemic properties. Bovine milk was used as a control. More than half of the analysed samples had low or no protein content (<0.5%). Only samples based on soy showed considerable high protein contents, reaching the value of cow's milk ($\geqslant$3.07%). Furthermore, the dispersion properties, particle size and viscosity were investigated. Since many of the samples contained stabilizers and other additives, no correlation could be found between physicochemical properties. However, most of the plant-based milks were highly unstable with separation rates up to 54.39 %/h. An in-vivo method to predict the glycemic index (GI) showed that the glucose concentration correlated with the GI (0.80, $p<0.001$). Hence, samples containing mainly glucose such as coconut- and rice-based milks had a high GI (>96). In general, the GI values ranged from 47 for bovine milk to 64 (almond-based milk) and up to 100 for rice-based milk.

This study demonstrates that nutritional and physicochemical properties of plant-based milks are strongly dependent on the plant source, processing and fortification. Some products showed low protein and high GI values. Therefore, consumer awareness is important when plant-based milks are used to substitute cow's milk in the diet. This leads to the challenge of improving the quality of plant-based milk substitutes.

Stephanie Jeske did an apprenticeship as a laboratory assistant in a laboratory for food and environment analytics and studied food technology at the University of Applied Sciences Bremerhaven. During her studies she did several internships, including one with CSM in the UK. In her final thesis she worked on the development of a new quinoa-based milk-like beverage under the supervision of Prof. Arendt at University College Cork. Stephanie graduated as Bachelor of Engineering (BEng) in Food Technology in 2015 and started her MSc (by research) project on the characterisation and development of cereal-based milks.

Advantage of using extrusion technology for the reduction of antinutritional factors in faba bean flour

Sultan Damla Bilgili[1], Aylin Altan[1], Faruk Doğan[2], Sibel Yağcı[2]

[1]Mersin University, Department of Food Engineering, Mersin, Turkey
[2]Karamanoğlu Mehmetbey University, Department of Food Engineering, Karaman, Turkey

sdbilgili@hotmail.com

- Production of nutritious snack foods
- Reduction of antinutrients
- Increase consumption of faba bean

Faba bean (*Vicia Faba L.*) is a nutritious high protein legume species for uses of both food and feed. Due to the high nutritional value of faba bean, it can be used for the production of nutritious snack foods by extrusion technique.However, the use of faba been has been limited due to presence of antinutritional factors. The objective of this study was to evaluate fermented faba bean flour using tarhana formulation for production of snack foods and to investigate the effect of extrusion process on phytic acid, condensed tannin and trypsin inhibitor contents of extruded foods.

Faba bean flour was fermented at 37°C for 6 h and subsequently dried in a forced air drier at 55°C for 24 h. Dried mixture was extruded at 18% moisture content in a co-rotating twin screw extruder with five heating zones (40-50-70-90-100°C) and a circular die (4 mm). The feed rate was kept as constant at a value of 2.5 kg/h. Three way factorial design at two levels was used for experimental design with factors of die temperature (130-150°C), screw speed (300-500 rpm) and gum level (1-4%). Phytic acid of faba bean flour was 14.41 mg phytate/g sample (d.b.) while phytic acid of extrudates was found in the range of 9.43 to 8.05mg phytate/g sample (d.b.). Not only extrusion process but also fermentation process was found effective for the reduction of phytic acid content in the products.

According to the analysis results, condensed tannin content of unprocessed faba bean flour was found 1.22 mg catechin/g (d.b.). Condensed tannin content of extruded products was in the range of 0.721-0.373 mg catechin/g (d.b.). Extrusion process decreased significantly condensed tannin content of extrudates when compared to the unextruded raw material. Trypsin inhibitor content of faba bean flour was 9.40 TUI/mg (d.b.). Extrusion process have a reduction effect on the trypsin inhibitor levels of extrudates.

These results suggest that it is possible to produce extruded foods from fermented faba bean flour with reduced antinutritional profile.

Sultan Damla Bilgili is a student at the University of Mersin. She received Master's Degree in the Mersin University and apply doctorate programme in the same university in this semester. The Sultan's master thesis title was ''The Effect Of Extrusion Process On Nutritional Properites Of The Faba Bean Extruded Products''. She also knows lots of information about nutritional properties of the legumes and how they change with process. She is a new master graduate and wants to join European Young Cereal Scientists and Technologists Workshop with an oral presentation for getting support from TUBITAK.

Particle size of dietary fiber preparation affects selected vitamin B bioaccessibility in fortified wheat bread

Marcin Kurek, Jarosław Wyrwisz, Sabina Karp, Agnieszka Wierzbicka

Warsaw University of Life Sciences, Faculty of Human Nutrition and Consumer Sciences, Division of Engineering in Nutrition

marcin_kurek@sggw.pl

- Increase in nutritional value of bread
- Development of easier fortification technology
- High content of dietary fiber bread

There is an interest in product development which could be enriched in dietary fiber and parallelly could be a solution for the decrease of bread consumption. The modern diet is responsible for the development of obesity and related diseases. Many research studies confirm the health promoting role of dietary fiber in preventing diseases of highly developed societies.

The problem which is encountered while fortifying bread with dietary fiber is lower quality attributes of the final product due to the high hydration properties. There are the research which solve this problem with decreasing the particle size of dietary fiber. However, the exposed hydroxyl groups could be a source of lowering the bioaccessibility of vitamins soluble in water. The aim of the study was to examine the bioaccessibility of thiamine (B_1), riboflavin (B_2), nicotinamide (B_3) and pyridoxine (B_6) in bread when the dietary fiber with different particle size is used.

The method was based on the HPLC determination of vitamin B_1, B_2, B_3 and B_6 content in bread with different particle size (280, 195, 100µm). Then each bread was digested using the *in vitro* digestion model. The chyme was separated and the vitamin B content was determined as well.

The estimation of level of vitamin B_1 and B_2 in bread from the study revealed that the decreasing particle size of dietary fiber could negatively influence the bioaccessibility of those vitamin but to certain extend. There is an intermediate level of micronization of dietary fiber which does not influence this parameter. The vitamin B_2 and B_6 are treated as most labile vitamins from the vitamin B group. Therefore, there was a small amount of them in the bread before the digestion due to higher thermodynamics processes during baking of fortified bread. Although, after digestion their level was insignificantly lower. In order to predict the particle size which could be used in fortification without significant decrease of vitamin B bioaccessibility the optimization was performed.

The research enabled to assess the optimal particle size of dietary fiber which could both be used in fortifying wheat bread without quality deterioration and influencing insignificantly the vitamin B level.

Marcin Kurek is a Research Assistant at the Warsaw University of Life Sciences in Poland. He holds a PhD in Food Technology and Nutrition and BA in Economy. The main aspect of his work is providing the food producers with the optimized technologies using statistical tools. Currently, he is working on improving the nutritional and technological quality of bakery products with dietary fiber. Marcin is a reviewer in a few international journals and a graduate of TOP500Innovators program at University of Cambridge.

Effect of cooking time on *in vitro* starch digestibility and bile acid binding capacity of pasta

Seher Serin, Özge Durkan and Sedat Sayar

Department of Food Engineering, University of Mersin, 33342 Mersin, Turkey

sserinkarayiyen@gmail.com

- Determination of bile acid binding capacity levels
- Determination of amount of resistant starch
- Investigation of nutritional benefits

Pasta is a popular carbohydrate-based food. It has an important place in the human diet since it can be easily prepared and economic. Pasta has consumed in different ways according to the cooking time. Pasta cooking time has shown to be influenced by starch gelatinization. The pasta with short cooking time termed as “al dente”. The starch in “al dente” pasta does not completely digested. Namely the “al dente” pasta contains resistant starch (RS). Resistant starches have physiological functions similar to dietary fiber. Dietary fiber reduces cholesterol levels more than %20 in the blood. Additionally, RS plays a role as a substrate for the colonic microflora in the large intestine. RS has positive effect to against the risk of type 2 diabetes, coronary disease, obesity and inflammatory bowel disease. The aim of this study was to investigate the possible nutritional benefits provided by the non-digestible part of pasta. Pasta was cooked in boiling water for 7 minutes for the “al dente” samples and for 11 minutes for the normally cooked samples. Samples were cooled after cooking and passed from an electric mincer. *In vitro* digestion analyses were performed by using the method given in Sayar et al., 2005. Bile acid binding capacity was determined by using Bile acid analysis kit (Bile Acid Kit: Product No: 450A, Trinity Biotec Plc, Wicklow, Ireland). The results showed that “al dente” samples have lower digestibility than the normally cooked samples, as expected. Bile acid binding capacities were determined to be considerably lower than the positive control cholestyramine. However, there was no significant difference between the bile acid binding capacities of the two samples that have different cooking time. In the continuation of this study, the digestion residues from these two different samples will be used as a substrate for colonic fermentation study in order to determine the extent and the products of in vitro fermentation and on the depletion of available carbohydrates during in vitro fermentation.

Seher Serin is a Research and Teaching Assistant at the University of Mersin. She is a PhD student in Department of Food Engineering. She has been studying investigation of in vitro digestibility, bile acid binding capacity and properties of in vitro fermentation of foods contained different types resistant starch.

Pasting, gel texture and drying properties of starch–molasses combinations

Gülden Gökşen, H. Ibrahim Ekiz, Esma Eser

Mersin University, Faculty of Engineering, Food Engineering Department, Çiftlikköy Campus

gulgok@mersin.edu.tr

- Paste and gel properties of different sugar/starch combinations
- Type of molasses is used
- Achieving high quality final products
- Strong interaction between molasses and starch

Starch plays an important role in developing food products. Pasting, gel textural and drying properties of starch are functional properties that determine applications of starch in the food processing industry. Molasses is a kind of viscous solution containing high levels and different kinds of sugar. Grape molasses contains 30.9 g/L glucose and 29 g/L fructose, carob molasses contains 13.6 g/L glucose, 10.6 g/L and 32.4 g/L sucrose. They are useful ingredient in many starch based foods. The pasting, gel textural and gel drying properties were analyzed in order to better understand the interaction between starch and molasses. The pasting properties of starch-molasses combinations and the textural analysis of starch gel has been carried out using a Rapid Visco Analyzer (RVA) and texture profile analysis (TPA) respectively. The pasting and textural properties of wheat starch in grape and carob molasses and the addition of grape and carob molasses to wheat starch in suitable proportions can be an optimum alternative to formulation of starch based foods. In this study, the pasting, gel textural of wheat starch having different concentrations of grape and carob molasses (1-30% w/w) were investigated at 90 °C, 92 °C, 95 °C and 98 °C. The high temperature of drying causes the formation of more brown compounds so we determined optimum drying temperature. The pasting properties were significantly affected by the molasses concentration. The increase in molasses concentration generally caused an increase in hardness, adhesiveness, gumminess and chewiness values. Textural properties of carob molasses-wheat starch interactions are higher affected than grape molasses- wheat starch interactions. Positive effects of sucrose on increasing peak viscosity, trough viscosity and final viscosity were enhanced at higher starch concentrations.

Gülden Gökşen is a Research Asisstant at the Mersin University. She holds a BSc.Honours in Food Engineering and a PhD in Food Sciences such as Cereal Science and Technology. Gülden study on PhD thesis subject is dietary and nano fiber produced using food waste. Gülden undertook her latest duties with TÜBİTAK Marmara Technopark is the Federal and Privately owned of innovation, technology and business incubation center as well as science and technology park. She and collageous have prepared European projects such as H2020 (RIA, IA), SMEInst, Erasmus+ KA2 etc.

Fundamental studies on the reduction of sugar in burger buns

Aylin Sahin, Elke K. Arendt

School of Food and Nutritional Science, University College Cork, Cork, Ireland

a.sahin@umail.ucc.ie

- Necessity of sugar in burger buns
- Possibility of a low sugar product
- Fundamentals as beginning for sugar reduction

Obesity increased in Europe in the last few years enormously. One reason is added sugar in almost every product at the supermarket. Before sugar can be reduced and replaced by other functional ingredients, the effect of this ingredient on the product has to be studied.

Sucrose highly impacts the physicochemical properties of burger buns and influences their dough quality. In order to study the effect of sugar on the quality characteristics of burger buns, the sucrose level of a control recipe was reduced from 10% (w/w) to 0% (w/w). The water content of the sugar-reduced recipes was adjusted to the control to achieve the same dough consistency.

The crust colour of the buns showed a significant decrease of the L* value ($P<0.01$) with increasing sugar level. Furthermore, the specific volume of the burger buns increased with higher sugar concentrations up to a level of 4% (w/w) sugar ($P<0.01$), followed by a slight decrease (5% to 10%). The slice area of the crumb correlated with the specific volume and no significant differences in number of cells and wall thickness were recognized for the different sugar levels. In addition, the evaluation of the crumb texture resulted in a softer crumb with increasing sugar level ($P<0.01$). Oscillation measurements of the dough showed that the reduction of the sucrose level decreased the viscous properties of the dough. Furthermore, a higher sugar level increasingly delayed the gluten network development and increased the extensibility of the dough. Beside that, shelf-life increased with increasing sugar level.

The results reveal how sugar at various levels impacts on dough and baked product quality and showed a possible reduction to 6% sugar in the bun without affecting the bun quality significantly.

Aylin Sahin studied Bioprocess Engineering (BSc) and Pharmaceutical Bioprocess Engineering (MSc) at Technische Universität München (TUM). During her studies, she worked as a research assistant on textured plant protein by using high moisture extrusion. Her master thesis focused on the influences of mechanical stress on the texture properties of gluten-free bread and was performed at the Fraunhofer IVV Freising. Aylin is currently doing her PhD at the School of Food and Nutritional Science, University College Cork. Her project focuses on sugar reduction in cereal products.

Maize inbred lines: nutritional and technological characteristics suitable for food

Michela Alfieri[1], Rita Redaelli[1], Miriam Zanoletti[2], Maria Ambrogina Pagani[2]

[1]Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria - Maize Research Unit, Bergamo, Italy;
[2]Departement of Food, Environmental and Nutritional Sciences, University of Milan, Milan, Italy

michela.alfieri@entecra.it

- Screening of maize inbred lines
- Chemical composition of the grains
- Interesting technological characteristics
- Potential application in the food industry

In many countries maize is largely grown as food for humans, whereas in Italy it is mostly used for animal feed or industrial uses. However, the diffusion of gluten intolerance or celiac disease among consumers in recent years suggested introducing larger amount of maize, a gluten-free cereal, into diets. In this context, it is important to identify the most suitable raw materials, from a nutritional and technological point of view. Consequently, a set of 28 maize inbreds were chosen for a preliminary screening of maize genotypes. The lines were multiplied in Bergamo during 2014 and reproduced by self-pollination. After harvest, their ears were dried, shelled and ground with a laboratory mill by a 0.5 mm sieve. Chemical analyses were carried out for the following parameters: crude protein, crude lipid, total starch, soluble phenols (SPs) and total antioxidant capacity (TAC). Pasting properties were also determined, in order to evaluate the potential value of these flours for the food industry. In this work the results of analysis in a subset of ten lines were reported: two lines with white kernels (Lo1224w and Lo1546w), two *amylose extender* genotypes (1413*ae* and 1489*ae*), four lines recently developed (Lo1481, Lo1501, Lo1530 and Lo1550) and two old lines (Lo18 and Lo446).

Old lines and the two *amylose extender* genotypes were characterized by the highest percentages of protein, lipid and TAC; Lo1546w presented a high value of TAC. Lo1481 and Lo1530 showed the highest values for peak viscosity and setback indices, suggesting the formation of hard gels that make their flours suitable for pasta making. On the contrary, flours from lines Lo1501 or Lo1550 presented lower setback and could be used as an ingredient for bread and biscuits. The two *amylose extender* flours were characterized by an unusual trend, without viscosity increase and gelatinization peak. In conclusion, some lines emerged for nutritional e functional features and could be exploited for the production of foods.

Michela Alfieri has a degree in industrial biotechnology at the University of Milan Bicocca. Since 2009 she has been working at Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria in Bergamo (Maize Research Unit) with different grants and collaborations. His latest researches had focused on the characterization of maize genotypes from the nutritional point of view, through the analysis of the content of starch, lipids, carotenoids, antioxidants, polyphenols.

Pigmented grains as a source of immunomodulating bioactives

Parisa Abbasi Parizad, Jessica Capraro, Alessio Scarafoni, Vera Lavelli, Miriam Zanoletti, Mauro Marengo

DeFENS, University of Milan, Italy

parisa.abbasi@unimi.it

- anthocyan- and fiber-rich fractions may be obtained by de-hulling of pigmented grains
- bioactive-rich fractions may be incorporated in pasta at nutritionally significant levels
- anthocyanidins profile in pigmented grain fractions is unique
- bioactive rich fraction show remarkable anti-inflammatory action "*in vivo*"

This study addresses the overall molecular properties of the phenolics and anthocyanins present in the outermost fractions of the pigmented varieties of common grains. These fractions were collected by de-branning and were used for preparing nutritionally enriched foods, with negligible or minimal detrimental effects on the microstructure and appearance of the final food.

Pigmented grains and controls were de-branned and milled - when required - in a lab-scale milling system. Analytical profiling of the phenolics in bran components/fractions separated by physical techniques was carried out by advanced LC methods. The immunomodulating effects of selected fractions from the separation procedures were assessed by using cytokine-stimulated biosynthesis of a luciferase-labeled reporter of gene activation on properly transformed Caco-2 cells.

Analytical profiling of the phenolics in the various fractions separated by physical techniques indicated that the outermost fraction obtained through debranning of pigmented grains represents a very rich (and convenient) source of phenolics (and fiber, as assessed by independent measurements). Further separation into classes and sub-classes of bioactives allowed to test individual species (or mixtures of closely related species) as for their immunomodulating potential. Immunosuppressive activity of the fractions used for pasta making was dose-dependent, and was much higher than that of antocyanins from grape skin at similar concentrations.

Enriched pasta was produced from wheat flour and from various types of bran from purple wheat. By using bran fractions obtained through a de-hulling step, it was possible to obtain pasta with fiber content in excess of 10%, and a content in anthocyanins in the 100 mg/kg range.

These studies provide some guidelines as for achieving selective enrichment in specific bioactive compounds through physical methods. Further "engineering" of these treatments could allow to obtain fractions enriched in components with specific biological effects when incorporated into actual foods, without affecting their sensory properties.

Parisa Abbasi Parizad completed her BS and MS studies in Mashhad, Iran. Following an IUBMB-sponsored visit to DeFENS in 2014, she is currently a PhD student in "Food Systems" at the University of Milan, trying to prepare bioactive-rich foods, and to test the effects of their consumption on specific functions in humans and on the intestinal microflora.

Phenolic acid and antioxidant activity evolution during kernel development of colored corn grain and relationship with mycotoxin contamination

Debora Giordano[1], Massimo Blandino[1], Amedeo Reyneri[1], Trust Beta[2]

[1]Dipartimento di Scienze Agrarie, Forestali e Alimentari, Università di Torino, Italy
[2]Department of Food Science, University of Manitoba, Winnipeg, Manitoba, Canada R3T 2N2

debora.giordano@unito.it

- Phenolic acid evolution during corn kernel development
- Resistance to mycotoxin contamination
- Bioactive compound content of colored maize

Corn (*Zea mays L.*) is one of the most cultivated and consumed cereal in the world. Corn red and pink ear rots are two of the major fungal diseases affecting corn production worldwide and therefore likely responsible for mycotoxin contamination. There is renewed interest in the identification of naturally occurring mechanisms which can reduce mycotoxin accumulation. Several constitutive or pathogen-induced plant endogenous compounds can inhibit mycotoxin biosynthesis. Phenylpropanoids and in particular phenolic acids, could play a role in this type of resistance mechanism as suggested by their ability to reduce *in vitro* fungal growth and mycotoxin accumulation.

In this investigation, Total Antioxidant Activity (TAA), free and cell wall-bound phenolic acids were analyzed during kernel development of four maize open-pollinated varieties and two representative hybrids, cultivated at the same site and characterized by a wide range of colors (dark red, red, yellow and white). Maize ears were randomly handpicked from plants at four growth stages, namely: end of the silking stage (about 5 days after silking (DAS)), blister stage (about 7 DAS), dough stage (about 32 DAS) and harvest maturity (about 75 DAS). TAA and phenolic acids were determined using QUENCHER and LC-MS/MS methods, respectively. Finally, an evaluation of the protective effects of phenolic acids towards mycotoxin contamination was employed.

TAA, free and cell wall-bound phenolic acids showed significant differences among corn types at different developmental stages. On average, a significant decrease in TAA, free and cell wall-bound phenolic acid content was observed from the end of the silking stage to harvest maturity. Ferulic, p-coumaric and caffeic acids were the main cell wall-bound phenolic acids during kernel development, while chlorogenic acid was the main free phenolic acid. A significant negative correlation was observed between free phenolic acids and TAA at the beginning of kernel development and deoxynivalenol contamination at harvest maturity, while no significant correlation was observed with fumonisin contamination. The findings on phenolic acids provide insight into their evolution during kernel development, evidence of their correlation with mycotoxin contamination and information about bioactive compound content of maize varieties and hybrids characterized by a wide range of color.

Debora Giordano is a PhD student at the Department of Agricultural, Forest and Food Sciences of the University of Turin. She is currently studying the supply chain of pigmented cereals, in order to identify mechanisms that reduce mycotoxins contamination and to develop new functional ingredients rich in antioxidant compounds.

Antioxidant scenario of value added bread supplemented with fenugreek

Imran Pasha, Behzad Afzal

National Institute of Food Science & Technology, University of Agriculture, Faisalabad-Pakistan

ipasha2001@uaf.edu.pk

- value addition of baked products
- probing indigenous sources of functional worth
- exploration of fenugreek for utilization in baked products
- increase in antioxidant status of bread

The lifestyle related disorders are attributed to deskbound living and poor dietary practices. As a response, diet based regimen is gaining importance to alleviate the prevailing health issues. In this arena, Fenugreek (*Trigonella foenum-graecum*) seeds and leaves are well recognized for imparting health besides incorporating flavor to dietary edibles. The results of the current study showed that fenugreek leaves and seeds are rich source of protein, fiber and minerals particularly iron and calcium, which offer immense opportunities for the development of value added products to improve nutritional and health status. Alongside, it contains fair proportions of nutrients and antioxidants, helpful in curtailing several metabolic ailments. The ground leaves and seeds were incorporated into wheat flour @ 5, 10 and 15% to formulate composite flour following the preparation of bread. The resultant bread containing fenugreek leaves powder @ 5% and seeds powder @ 10% showed higher acceptability. The phytochemical analysis of the resultant bread revealed TPC 198.00±9.10 & 341.00±16.02 mg GAE/100g and total flavonoids 2.47±0.08 & 2.68±0.10 mg CE/g, DPPH scavenging activity 37.00±1.59 & 49.00±2.20%, β-carotene & linoleic acid assay 31.00±1.42 & 40.00±1.88% and FRAP 201.00±9.24 & 401.00±18.44 µmol Fe^{2+}/g, respectively for fenugreek leaves & seeds powder. It is therefore inferred that apart from flavor and fragrance, fenugreek leaves and seeds have a lot to offer in terms of health improvement. Conclusively, fenugreek based dietary approach is recommended for boosting health and suppressing metabolic ailments.

Imran Pasha is currently working as Associate Professor at University of Agriculture, Faisalabad-Pakistan and completed his PhD in Cereal Science and is an active member of AACC. He is working in domain of food science particularly grain science, functional foods and food analysis. In addition to teaching under- and post graduate courses, he has completed many projects related to grain science sponsored by various national and international organizations while currently working on three projects. Imran is enjoying a wonderful collaboration with food industry in the country. He also has good publication record in his credit with more than 65 impact factor.

Enrichment of gluten-free doughs and breads with β-glucans extracted from *Pleurotus ostreatus*

Sandra Perez-Quirce, Pedro A. Caballero, Felicidad Ronda

Department of Agriculture and Forestry Engineering, Food Technology, College of Agricultural and Forestry Engineering, University of Valladolid, Av. Madrid, 44, 34004 Palencia, Spain

sperez@iaf.uva.es

- Approach to a new ingredient approved by EFSA
- Development of new gluten-free products
- Increase in nutrition and quality benefits

β-glucans are polysaccharides present in the cell walls of cereal grains (especially oats and barley) and also in fungi and yeasts. These last contain mainly (1-3)(1-6)-β-glucans. Several studies have shown β-glucans from fungi have health beneficial effects, such as lowering cholesterol or antitumor, antioxidant and immunomodulatory effects, depending on their concentration, molecular weight and solubility. They have been recently approved as a food ingredient by European Commission following safety reports issued by EFSA.

However, their food applications are still unexplored. Therefore, this work has approached the study of fortification with (1-3)(1-6)-β-glucans from *Pleurotus ostreatus* extract incorporated in four doses (0%, 0,5%, 1% y 2%) to gluten-free doughs and breads. The study was focused on their effect in doughs at a constant hydration, and in gluten-free breads with adapted hydration, with the target of finding a nutritional and organoleptic improvement to the already unbalanced gluten-free diet.

From the results obtained, we can conclude that the addition of fungi β-glucan, regardless the dose, led to stiffer doughs, being necessary an increase on the hydration proportionally to β-glucan concentration. Regarding breads, it is demonstrated that β-glucans can be added to gluten-free bread without adversely modify the main physical properties of bread quality and life helpful. The addition of β-glucans caused an increase in the specific volume of the breads, a reduction on their hardness and brighter breads. A reduction on the hardness of the breads during their aging was observed in breads containing β-glucans.

Sandra Perez-Quirce is a PhD student at the University of Valladolid (Spain). She obtained a BSc in Agricultural Engineering (specialization in Food and Agricultural Industries). Then, she started her work as a researcher under a project of the Ministry of Education and Science. At the same time, she continued her studies to obtain a MSc in Quality, Development and Innovation in Food. Subsequently, she started her PhD in 'Food and Agricultural Engineering and Bio-systems' on the development of gluten-free products enriched with betaglucans from different origins and molecular weights. During her PhD, she carried out a doctoral stay at the Aristotle University, under the direction of A. Lazaridou and C. Biliaderis. Currently, she is also collaborating in research projects with companies.

Incorporation of black carrot pomace powder into bread as an antioxidant

Betül Bay, Gülden Gökşen, Nüzhet Türker, H. İbrahim Ekiz

Department of Food Engineering, University of Mersin, 33342 Mersin, Turkey

betulbay@mersin.edu.tr

- Increase in antioxidant and health benefit
- High antioxidant and fiber capacity
- Functional bakery products
- Healthy diet

Anthocyanins, water-soluble colouring pigments, are the most abundant found pigments in nature and impart a characteristic colour ranging from blue to red. Nowadays, there has been a great interest in anthocyanins not only their colorant abilities and aesthetic value but also their being rich in terms of bioactive compounds, and their potential role in reducing the risk of coronary heart disease, cancer and stroke.

The aim of this study was to examine the changes of antioxidant capacity of bread affected by fortification with powdered black carrot pomace. This presents on the effect of black carrot pomace addition from 0% to 5% (w/w) on total phenolics content, antioxidant activity, instrumental texture and colour profile, and sensory attributes of bread. The color development of bread crust and crumb was measured and expressed as L*a*b values. While the color of bread crust was significantly subjected to variations in oven operating parameters, the color of bread was relatively less affected by baking conditions.

As a color analysis, there were no browning of anthocyanins because of heating conditions. The total phenolics content and antioxidant capacity of breads' were determined. An increase of about 1.8-folds for crumb and 1.6-folds for crust in antioxidant capacity, 3.2-folds for crumb and 2.2-folds for crust in phenolics content for bread fortified with carrot pomace powder 5% of was observed, respectively, compared to the control. Results showed that in bread crumb and crust, both the antioxidant capacity and the total phenolic content increased with carrot pomace powder fortification.

Addition of 1%, 2.5% and 5% carrot powder pomace incrase the stiffness of the breads a little; the strength, which was 7.843 N in the control sample increased to 13.008 N in the sample fortified with 5%powder. It is considered that due to the high fiber content of the black carrot. Results of the study suggest that the fortification of anthocyanins into bread could be an alternative way to produce functional bread. The study suggests that the black carrot fortification to bakery products is a simple way to increase antioxidant content.

Betül Bay is a Research and Teaching Assistant at the University of Mersin. She holds a BSc.Honours in Food Engineering and she is a PhD student in the same university at Department of Food Engineering. She has been studying anthocyanins, degradation kinetics of anthocyanins, copigmentation methods to improve the stability of antocyanins.

Impact of sodium chloride on moisture sorption of starches

Anja Funch Brøgger and Sandra Hill

University Of Nottingham, School of Biosciences, Division of Food Science, Sutton Bonington Campus

stxafbr@nottingham.ac.uk

- Interaction of starch and salts
- Dynamics of water content in low moisture mixed samples
- Molecular and particulate behaviours on water absorbance
- Impact of processing on behaviour

In addition to flavour sodium chloride has been shown to have a pronounced impact on the properties of starches when processed at high temperatures. As expected, one action of the inclusion of salts into a blend of starches would be to change the equilibrium moisture content. The concept that moisture levels may change during hydration and dehydration based on salt levels is important when considering the mobility of the matrix and therefore its characteristic low moisture rheology.

Hydration of starches and blends of starches over saturated sodium chloride (NaCl) demonstrated that all the starches had an equilibrium moisture content of between 13-18% (WB). Static hydration of some commercial starch blends over water and NaCl showed marked differences; greater than expected from the small variations shown by the native starch. Therefore the sorption isotherms of these starch blends were ascertained using dynamic vapour sorption at 25 °C. For target RH values between zero and 60% the three commercial starch blends looked similar, but at higher humidity the isotherms were not comparable; one sample having a moisture content of 30%, while another was 60% (DWB). It was ascertained that sodium chloride was present in these blends and that by adding the salts to each of the commercial blends the same sorption isotherm could be obtained. Interestingly, the time when the salt was added in the process was relevant to the sorption isotherm, i.e. either dry mixed, or added during pasting and then dried. It is possible that this is an effect of particle size. However, the rates of moisture uptake and the equilibrium values do suggest that NaCl may impact differently depending of the state of the starch. This may be relevant to starchy materials used to create a product at low moisture content.

Anja Funch Brøgger is a 3rd year PhD student at University Of Nottingham, UK. She obtained her BSc and MSc degrees in organic chemistry from Aarhus University, Denmark in 2011. Anja is currently working on starch blends and trying to understand the physicochemical behaviour of the individual starches in order to understand the complex system of starch blends.

A lipase based study of wheat endogenous lipid and puroindoline functionality in bread making with flour from near-isogenic wheat lines

Sara Melis, Anneleen Pauly and Jan A. Delcour

Laboratory of Food Chemistry and Biochemistry and Leuven Food Science and Nutrition Research Centre (LFoRCe), KU Leuven, Kasteelpark Arenberg 20 box 2486, B-3001 Leuven, Belgium

sara.melis@biw.kuleuven.be

- Wheat flour lipids and puroindolines co-determine bread quality characteristics such as loaf volume and crumb structure
- Lipases improve loaf volume through (selective) hydrolysis of wheat endogenous lipids
- Puroindoline protein type in wheat flour has no impact on lipid hydrolysis by lipases

Even if they are minor constituents of wheat flour, lipids and puroindolines (PINs) co determine bread quality, although their role is not entirely clear. PINs are small proteins with surface active and lipid binding properties. Two types, PINA and PINB, exist, the functionality of which in bread making depends on the lipid population present. We here used lipases with different hydrolysis selectivity in bread making with flour from near-isogenic wheat lines (NILs) differing in PIN protein type. Lipases selectively modify the flour lipid population without altering other flour constituents whereas the applied NILs are genetically identical except for the chromosome region where PINs are encoded. Lipase impact on loaf volume was evaluated and related to changes in lipid population during fermentation. Two lipases, Lecitase Ultra and Lipolase, were applied in different concentrations in small scale bread making with flour from cultivar Alpowa (wild-type, both PINA and PINB present) and a NIL derived thereof (PINA null, no PINA present). For both flour types, Lecitase Ultra was optimally dosed at 0.5 and Lipolase at 0.2 mg enzyme protein/kg flour. At this optimal concentration, loaf volume increase was more pronounced with Lecitase Ultra than with Lipolase. Furthermore, larger volume increases were reached with wild-type flour than with PINA null flour. Lipase hydrolysis patterns were, however, similar for both flour types. Lecitase Ultra had a broad hydrolysis specificity since neutral, galacto- as well as phospholipids were hydrolysed. Lipolase on the other hand had a more narrow specificity towards neutral lipids but also hydrolysed (to a lower extent than Lecitase Ultra) monogalactosyldiacylglycerols. In spite of its more selective action mechanism, Lipolase released more free fatty acids than did Lecitase Ultra. In conclusion, this study revealed only minor differences in lipase impact when applied in bread making with flour from NILs differing in PIN protein type. Furthermore, in agreement with earlier findings, hydrolysis of phospho- and galactolipids improved loaf volume. However, in contrast to what has been reported in the relevant literature, selective hydrolysis of non-polar lipids also led to significant volume improvement.

Sara Melis is a PhD-student at the University of Leuven, Belgium. She holds a Master degree in Bio-Science Engineering with a focus on food technology. After her graduation in 2014, she started her PhD on the functionality of wheat endogenous lipids and puroindolines in bread making at the Laboratory of Food Chemistry and Biochemistry under supervision of Prof. Jan Delcour. This laboratory mainly concentrates its efforts on cereal constituents and how they influence food production and quality, and is a member of the Leuven Food Science and Nutrition Research Centre (LFoRCe).

Functional properties of native maize and extruded flours modified by branching enzyme and maltogenic α- amylase

Laura Román[1], Mario M. Martínez[1], Cristina M. Rosell[2], Manuel Gómez[1]

[1]Food Technology Area, College of Agricultural Engineering, University of Valladolid, 34004 Palencia, Spain;
[2]Institute of Agrochemistry and Food Technology (IATA-CSIC), 46980 Paterna, Spain

laura.roman@iaf.uva.es

- Combination of extrusion and enzymatic treatment
- Increase in enzymes accesibility
- Pasting properties
- In vitro starch digestion

Nowadays, extrusion is widely used in snack and breakfast cereal productions. From a nutritional perspective, extruded-cooked products are characterized by a fast digestion rate. According to recent studies, the long-term consumption of fast digestible starchy products may contribute to promote human diseases such as type II diabetes, cardiovascular disease or obesity. By increasing the content of α-1,6 branch points and the ratio of short chains to long chains in starch, digestibility by human amylolytic enzymes is expected to be retarded.

In this study, an enzymatic treatment with branching enzyme (B) and a combination of branching enzyme and maltogenic α-amylase (BMA) was carried out in native and extruded flours in order to modulate their digestion properties. The starch hydrolysis of the treated flours was assessed, besides the microstructure, pasting properties and resistant starch content.

Photomicrographs showed that BMA treatment led to greater number of holes on the granule surface for native samples compared to B treatment. For both B and BMA extruded samples a rougher surface with cavities was observed.

An increase in the peak viscosity and a reduction in the retrogradation trend were observed for B and BMA native flours. Meanwhile, enzymatically treated extruded samples showed very low viscosity and flat pasting profile consequence of the enzyme activity on the starch chains.

For starch hydrolysis, no significant differences were observed for $C\infty$ at the end of the curve. Extruded samples still presented higher hydrolysis rates (k) at the early hydrolysis stage than their native counterparts. It is noteworthy to remark that glucose release increased gradually for native flours as the time of reaction did, whereas for extruded flours a fast increase of glucose release was observed during the first 10 minutes of reaction, and kept till the end, indicating that some fractions were kinetically resistant to hydrolysis. Nevertheless, after 16 h of hydrolysis, resistant starch content was lower for treated extruded samples. The increase in the amount of shorter chains and more number of α-1,6 linkages in treated extruded samples did not contribute to slow down the digestion properties.

Laura Román is a PhD candidate in Food Science and Technology at the University of Valladolid conducting research on the study and application of extruded flours for the development of products with better functional, organoleptic or nutritional properties. As a result of this work, Laura has published 7 articles in SCI journals (four of them as first author). Laura was Finalist in Isydore Hlynka Student Paper Award by Rheology Division of AACCI. Laura received the Extraordinary Award Upon Graduation in Official Master's Degree in Quality, Development and Innovation of Food as well as in Technical Agricultural Engineering, specialization in Food and Agricultural Industries.

Impact of gluten protein hydrolysis during baking on gluten network formation and crumb texture in wheat bread

Annelien Verbauwhede, Ellen Fierens, Kristof Brijs and Jan Delcour

KU Leuven, Faculty Bioscience Engineering, Laboratory of Food Chemistry and Biochemistry and Leuven Food Science and Nutrition Research Centre (LFoRCe)

Annelien.verbauwhede@biw.kuleuven.be

- Gluten hydrolysis at temperatures above starch gelatinization temperature has a small impact on bread texture.

The importance of gluten proteins in bread making has largely been described, especially during mixing and fermenting. A good quantitative and qualitative combination of gliadins and glutenins leads to a dough with the right visco-elastic properties and will result in gas cell expansion (viscous properties) and gas cell stabilization (elastic properties) during fermentation. Functionality of gluten proteins during baking phase is less studied. Therefore, a thermoactive peptidase was used in bread making, as a tool, to gain insights in gluten functionality during baking phase towards final crumb texture. First the onset temperature for gluten hydrolysis during baking phase was evaluated using Size Exclusion High Performance Liquid Chromatography (SE-HPLC). Drastic changes in the molecular weight distribution of the gluten proteins [under reducing conditions (buffer containing sodium dodecyl sulfate (SDS), dithiothreitol (DTT) and urea)] due to hydrolytic activity started around 80 °C. Rapid Visco Analyzer analysis of heated gluten suspensions showed a clear weakening of the formed gluten network in the presence of the peptidase. Hydrolytic activity during baking phase results in a 20% higher total extractable protein when the extraction medium contained SDS but no DTT and urea. Although these results clearly indicate an impact on gluten network formation during baking, only small differences were measured on crumb texture. This is probably because the hydrolytic activity is most pronounced at temperatures above the gelatinization temperature of starch in dough, i.e. 64 °C. It can be hypothesized that gluten functionality is less important for the final crumb structure during baking at temperatures above 80 °C.

Annelien Verbauwhede is a PhD-student at the University of Leuven, Belgium. She holds a Master degree in Bio-Science Engineering with a focus on food technology. After her graduation in 2014, she started her PhD on the investigation of endopeptidase activity in bread making at the Laboratory of Food Chemistry and Biochemistry under supervision of Prof. Jan Delcour. This laboratory mainly focusses its efforts on cereal constituents and how they influence food production and quality, and is a member of the Leuven Food Science and Nutrition Research Centre (LFoRCe).

Exopolysaccharides production during the fermentation of faba bean flour by *Leuconostoc mesenteroides* DSM 20343

Yan Xu, Rossana Coda, Qiao Shi, Päivi Tuomainen, Kati Katina, Maija Tenkanen

Department of food and environmental science, P.O. Box 27, FI-00014 University of Helsinki, Finland

- *In situ* production of exopolysaccharides in faba bean dough
- High viscosity of faba bean dough after fermentation
- Meet consumers' needs in "clean labels"
- New possibilities for faba bean

Microbial exopolysaccharides (EPS), glucans and fructans, have gained increasing attention during recent years for their texture modification properties. Faba bean (*Vicia faba L.*) is a legume growing in different climatic areas around the world and it is a traditional and important crop for food and animal feed in Europe, Africa and Asia. Recently, the research interest on legumes in food industry has increased due to the reduced meat consumption. In this study, faba bean flour was fermented by *Leuconostoc mesenteroides* DSM 20343 with different contents of sucrose or raffinose. After fermentation, the viscosity of faba bean dough with 15% (w/w) of sucrose increased considerably. The contents of sucrose metabolites, such as glucans, fructans, lactic acid, acetic acid and mannitol produced in faba bean doughs during fermentation were all quantified. The results revealed that both glucans and fructans were produced by this strain. Glucans were found to be more efficient in viscosity improvement than fructans. In addition, the degradation of raffinose family oligosaccharides (RFOs) in faba bean doughs was studied. The results showed that some of the fructans in faba bean doughs were produced from FROs. The main aim of this study was to provide new possibilities for faba bean flour.

Yan Xu is a PhD student at the University of Helsinki. She started her doctoral research in November, 2014. She focuses on applying exopolysaccharides-producing lactic acid bacteria in tailoring legume flours and studies the interactions between legume proteins and exopolysaccharides. The aim of her research is to find new possibilities for legumes in food use.

Impact of durum wheat grain composition on semolina yield and pasta quality

Marianne Joubert[a,b], Valérie Lullien-Pellerin[a], Marie-Hélène Morel[a]

[a]INRA, UMR IATE, 2 place Viala, 34060 Montpellier Cedex 01, France
[b]Panzani, CRECERPAL, 131 av. Corot, 13013 Marseille, France

marianne.joubert@supagro.fr

- Durum wheat, semolina yield and pasta quality
- Protein and ash content
- Starchy endosperm particle size distribution

In Italy, France and Greece, traditional dried pasta are manufactured exclusively from durum wheat semolina and water. Thus, spaghetti quality is directly linked with the durum wheat grain quality. This talk demonstrates how the durum wheat grain composition and physical attributes affect semolina yield and composition and finally the pasta quality.

Five durum wheat grain samples, grown in 2014 under different nitrogen doses, were characterized in terms of mass, texture and mechanical properties and biochemical composition and transformed on a milling pilot plant (scale 150kg) delivering 18 different fractions. Yield in the different flour and semolina fractions, as well as their biochemical composition (content in protein, ash, phytic acid, damaged starch, total starch) and physical attributes (particle size distribution) were determined and related to the grain characteristics. In particular semolina yield was found related to grain vitreousness and grain protein content. The different milling fractions were combined in order to compose eighteen different semolina blends, representing six levels of protein content (9.2 to 13.5%) , four levels of ash content (0.65 to 1.16%) and three particle size distributions (D50 from 230 to 600 µm). Each variable (protein, ash, D50) was tested at different levels, values of the other two being fixed. In this a way, an experimental design was constituted. The semolina blends were transformed into pasta on an experimental press (scale 10 kg) and dried using standard low and high temperature diagrams. Color and defaults (speck, spots and cracks) of the dried spaghetti quality were assessed. Cooking quality of pasta was evaluated by measuring pasta visco-elasticity after optimal cooking time +6min.

The study confirms that a high ash content decreases significantly the yellowness and the brightness index of pasta. Semolina particle size distribution impacts also the pasta color, coarser semolina leading to brighter pasta. A significant positive effect of semolina protein content was shown on the viscoelastic index of pasta. This approach allows a non-distorted estimate of how each variable impacts the pasta quality.

Marianne Joubert is a second year PhD Student at French National Institute for Agricultural Research in Montpellier (France) within the Joint Research Unit on Agropolymer Engineering and Emerging Technologies. Her PhD topic is focused on the adaptation of the durum wheat grain processes, milling and pasta making, to grain variabilities. Her work is part of a French National Research Agency project about agronomic, technologic, and organizational innovations to improve the sustainability of the durum wheat chain. This study is also supported by a French pasta-manufacturing company.

Carbohydrate composition of Hungarian triticale genotypes

Bernadett Langó[1,2], Ravindra Chibbar[3], Sarita Jaiswal[3], Erika Ács[2], Lajos Bóna[2], Sándor Tömösközi[1]

[1]Budapest University of Technology and Economics, Department of Applied Biotechnology and Food Science, Budapest, Hungary
[2]Cereal Research Non-profit Ltd., Szeged, Hungary
[3]University of Saskatchewan, Department of Plant Sciences, Saskatoon, Canada

bernadett.lango@mail.bme.hu

- triticale for human consumption
- similar starch structure to the parental species
- higher arabinoxylan content than wheat

Triticale (X *Triticosecale* Wittmack) is the first man-made cereal (product of wheat (*Triticum* sp.) and rye (*Secale* sp.) hybridization), mainly used as an animal feed. However it is certainly appropriate as food, the use for human utilization still uncertain. Cereal foods are on essential part of the daily diet (50% of the daily carbohydrate intake comes from different type of cereals) and people become more health conscious in general. This leads the current customer trends and increased the interest on triticale in the last few decades.

In this study, 11 hexaploid triticale genotypes (cultivars and advanced lines) along with reference wheat and rye varieties were investigated. We measured the starch content and characteristics (amylose-amylopectin ratio, structure, hydrolysis index, granule particle size) and the amount of dietary fibers and components (arabinoxylans, β-glucan, resistant starch).

Starch is the major storage polysaccharide in cereals, the concentration in triticale (61.3-70.1%) is close to the value of wheat. The average amylose content of the triticale genotypes is around 24%, which is lower than the control wheat and rye. The starch hydrolysis profile was faster in the case of rye, but some of the triticale genotypes showed favorable properties compared to the wheat line. Triticale contains higher amount of large a-granules. The other part of the carbohydrates which is resistant to digestion by the human gastrointestinal tract, called dietary fibres showed values ranging from 10.2 to 14.4%. Adequate dietary fibre is essential for proper functioning of the gut and has also been related to risk reduction for a number of chronic diseases including heart disease, certain cancers and type II diabetes. In triticale, nearly 50% of the dietary fibre present as arabinoxylans (4.9-7.4%), in some genotypes the content was even higher than rye. β-glucan concentration was unified to all the triticale entries, around 1%. On the other hand, the difference between triticales was significant in case of resistant starch (2.3-9.9%), some value exceeded the value of the rye.

The tested Hungarian triticales showed similar carbohydrate composition compared to the parental species, however we found differences between the genotypes. This fact could open up the opportunity for targeted selection during the breeding process.

Bernadett Langó is a Research Fellow at Cereal Research Ltd., Szeged (Hungary). She was started her PhD in 2013, at Budapest University of Technology and Economics's György Oláh PhD School. Her thesis is about triticale breeding and research (nutritional values and end-use quality).

Description of rolling as unit operation during the couscous process

Bettina Bellocq

UMR IATE, GENIAL, PIHM, Montpellier SupAgro, University of Montpellier, INRA, CIRAD

bettina.bellocq@supagro.inra.fr

- Optimisation of couscous processing
- New physical approach on rotating drum
- Increase in efficiency of rolling process

Couscous agglomerates are made from durum wheat semolina by the succession of 4 unit operations: agglomeration, rolling, cooking and drying. Rolling stage is conducted to give a spherical shape to the agglomerates and to separate them according to size criteria. Continuous rolling drum is used by industry, and for some of them it is composed of an inclined perforated cylinder rotating about its central axis. The rolling stage is one critical operation during the couscous grain processing, as rolling mainly determines the process yield, by generating significant mass flows of too small and too large agglomerates that could reach more than 60% of the total mass flow. The objective of the present work is to investigate the rolling stage as a unit operation, to determine the rolling process efficiency and its contribution on the structuring mechanisms of the couscous agglomerates.

We used specific rolling equipment at pilot scale. Two metal grids allow separating the agglomerates in three fractions: fine, medium, and large agglomerates. Durum wheat semolina was used as raw materials to generate the wet agglomerates by a standard procedure. We investigated (i) the screening efficiency by assessing the three fractions yield, (ii) the rolling efficiency by measuring the circularity of agglomerates after rolling; (iii) the secondary agglomeration mechanisms by comparing the size distributions of the agglomerates before and after rolling; and (iv) the impact of rolling conditions on the hydro-textural characteristics of agglomerates.

Results demonstrated that the rolling operation induces slight changes in the structure of the agglomerates and generates secondary agglomeration mechanisms. The change in setting conditions of the rolling operation has no significant impact on the screening efficiency and on the hydro-textural characteristics of agglomerates (diameter, compactness, and water content). A physical approach was conducted to determine both the sieving and passing speeds of agglomerates and showed that classification function of the rotating drum can be greatly improved.

Bettina Bellocq is in her second year of PhD in process engineering and food science. Her PhD subject purposes a multi scale approach to control and redesign the transformation of durum wheat semolina in couscous grains. The context of this thesis is based on the connection between physics of granular media and food science. Bettina is a member of Agreenium's International Research School. She is currently supporting a knowledge transfer partnership with the University of Cambridge.

The potential benefits of wheat pearling prior to milling for producing bran with improved nutritional and technological properties

Niels De Brier and Jan A. Delcour

Laboratory of Food Chemistry and Biochemistry, and Leuven Food Science and Nutrition Research Centre (LFoRCe), KU Leuven, Kasteelpark Arenberg 20, 3001 Leuven, Belgium

niels.debrier@biw.kuleuven.be

- Wheat pearling prior to milling is a way to obtain aleurone-enriched bran
- Large differences in element distribution exist within different wheat bran tissues
- Aleurone-enriched bran has good potential for being part of the ingredient bill of bran-rich breakfast flakes

Wheat (*Triticum aestivum* L.) bran is separated from white flour by milling. Miller's bran mainly consists of the outer layers of the grain (pericarp, seed coat, nucellar epidermis and aleurone) and contains a large and diverse group of nutritional compounds such as dietary fiber, protein, minerals, vitamins, ... However, wheat bran is used in cereal-based human food production to only a limited extent because doing so deteriorates food texture, organoleptic profile and shelf life. This study is devoted to the potential of using pearling prior to milling as a way to improve the functionality and nutritional value of wheat bran. Pearling is a mechanical process in which the outer layers of wheat grains are removed by abrasion but does not remove the kernel outer tissues homogeneously as abrasion affects especially the accessible parts of the kernels. Nevertheless, the first 3% removed consist of mainly pericarp. The regular bran and that obtained by subsequent roller milling of pearled wheat kernels have similar compositions but the latter have a lower average particle size and a relative increase in aleurone. Because of the importance of minerals in wheat and their bio-accessibility, their concentrations, speciation, and spatial distribution were studied in intact and pearled wheat grains. The xylem mobile elements such as manganese, silicon, calcium and strontium are dominant in the most outer bran layers while phloem mobile elements such as magnesium, iron, zinc and copper are rather concentrated in the aleurone and stored as phytate structures. Abrading the most outer bran layers lowers the concentrations of the xylem mobile elements in the bran fractions obtained by roller milling. The potential of the fractions obtained by pearling prior to milling as food ingredient was investigated by including them in the ingredient bill of bran-rich breakfast flakes. Flakes containing 40% residual bran, obtained by removing 4% of the grain by weight prior to milling, are more crispy and better maintain hardness during soaking in milk than their regular bran containing counterparts.

Niels De Brier is since December 2015 a postdoctoral fellow at the laboratory of Food Chemistry and Biochemistry of KU Leuven. He received his BSc, MSc and PhD in Bioscience Engineering from the KU Leuven. His current research focuses on the impact of wheat processing on the bio-accessibility of grain's bio-active compounds. At the same time, Niels intends to apply and valorize his findings for developing and optimizing the production of health-promoting food systems. Niels (co-)authored 6 peer-reviewed publications and is a member of the AACCI.

A comparative study on bread staling when baking with ohmic heating or conventional baking using a Peltier baking module

Timothée Gally, Priyadarshini S. Rajkumar, Alain Le-Bail, Olivier Rouaud, Vanessa Jury

ONIRIS - GEPEA (UMR CNRS 6144), Site de la Géraudière CS 82225, 44322 Nantes cedex 3, FRANCE

timothee.gally@oniris-nantes.fr

- Ohmic heating permits faster temperature increase and volumetric heating
- Amylopectin recrystallisation is accelerated
- Bread firmness is reduced during storage

Ohmic heating, also known as Joule heating or resistive heating, is a heating process based on the passage of an electrical current through a material, which is used as an electrical resistance. The principle of this process is based on Joule's law. This process has been used for bread baking a few times, showing that it was possible to produce crust-less bread.

In this work, the aging of nonyeasted bread was studied using an ohmic cell developed in our lab. Different baking patterns were analyzed: until 98°C maintaining the temperature during 0, 5 and 10 min. The same kinetic as with conventional baking was used, i.e. 5°C.min^{-1}. The same tests were carried out by baking with Peltier module in the same conditions.

The samples were analyzed at different storage times: hour 0, 4, 24, 16, 32 and 48. Their firmnesses as well as the Young's modulus (DMA), amount of soluble amylose, amylopectin recrystallization, and water content were analysed. The organization of starch granules was also studied by microscopy.

The results tend to show that most of the amylopectin recrystallisation happens in the first 48 h following the ohmic heating, while it is more evenly distributed in the case of conventional heating. Bread firming increases with the storage time, but at a lower rate in the case of ohmic heating. Also, the amount of ungelatinised starch is higher after ohmic heating than conventional heating.

Ohmic heating process could be used for baking crust-less bread faster and with lower energy consumption. In addition to developing the process, the results will be used to understand the impact on the final product better.

Timothée Gally is a PhD student from ONIRIS, GEPEA laboratory. He holds an Engineer's degree in Food Industry from Montpellier SupAgro, France. His research field is about low energy baking processes, focused on ohmic heating.

Relation between adhesion properties of cereal doughs and microbial contamination of proofing trays - Influence of the surface character

Rita Laukemper, Mario Jekle, Thomas Becker

Technical University of Munich, Institute for Brewing and Beverage Technology
Research Group Cereal Process Engineering, Freising, Germany

rita.laukemper@tum.de

- Development of methods to measure stickiness
- Correlation between stickiness and contamination
- Increase in efficiency and hygienic safety

Due to adhesion phenomena dough often stick to the material surfaces such as proofing trays in the production of bakeries. This leads to reduced output, to microbial contamination and therefore often machine cleaning downtime and higher production costs. To reduce the bonding, it is essential to develop a better understanding of the interaction between dough and material surface.

In context of this study methods to determine the adhesion of dough to different material surfaces have been developed. A further purpose is a detailed reconnaissance on physical and chemical level. To take into account the hygienic aspect, the relationship between the bonding and the microbial contamination of the different surfaces are investigated.

The adhesive force between dough and a material surface is influenced by different factors, such as the material surface structure and composition, as well as the duration of contact of the two contact partners, as previous studies have shown. Previous existing methods for the determination of stickiness, however, are not designed to analyse the adhesion behaviour after different contact times between dough and material. In order to detect the separation behaviour of dough even after practical contact times, a new measurement method for this purpose was developed in this work. Using this method differences concerning the adhesion behaviour for higher contact times have been shown according to material composition and structure.

Furthermore and in order to analyse the important aspect of the correlation between adhesion and microbial contamination an adjusted method was applied to determine the contamination of textile surfaces like proofing trays. In this context a detailed industrial scaled research of the microbial contamination of proofing trays varying in composition and structure is done.

For a precise elucidation of the adhesion behaviour different influencing factors have to be considered: the influence of mechanical adhesion is determined by defining the effective contact surface. The specific adhesion was analysed by identifying the surface energy of two contact partners.

The better understanding of the adhesion phenomena and their correlation with microbial contamination enables a future targeted selection of materials with low adhesion taking hygienic safety into account.

Rita Laukemper is a PhD student at the Technical University of Munich. She holds a Diploma in Food Technology from the Technical University in Berlin and is currently undertaking research duties at the Institute for Brewing and Beverage Technology in Freising where she is trying to understand the mechanisms of adhesion phenomena of cereal dough.

Baking performances of sprouted wheat flour

Anja Nicolodi[1,2], Gaetano Cardone[1], Regine Schönlechner[2], Maria Ambrogina Pagani[1], Alessandra Marti[1]

[1]Department of Food, Environmental and Nutritional Sciences (DeFENS), University of Milan, Italy
[2]Department of Food Sciences and Technology, BOKU-University of Natural Resources and Life Sciences, Vienna, Austria

anja.nicolodi@students.boku.ac.at

- Wheat sprouting in controlled conditions
- Improvement of bread characteristics

Sprouting is an ancient method associated with improvements of the nutritional and sensory properties of cereals and pulses. Severe and uncontrolled grain sprouting induces high accumulation of enzymatic activities that negatively affect dough rheology and baking performance. Using of sprouted grains for baking, thus, has been restricted until now. The present work addressed the effects of sprouting – which was carried out in controlled conditions (temperature and humidity) - on wheat dough rheological properties and baking performance. Adding flour from sprouted wheat (from 15 to 100%) significantly decreased the dough water absorption, development time and stability during mixing, while the degree of softness increased, suggesting gluten weakening. Interestingly, 50% sprouted wheat enrichment enhanced the leaving properties of dough with respect to dough development and gas production, and the overall baking performance. Indeed bread containing 50% sprouted wheat showed a higher volume and a softer crumb compared to the control bread, even after three days of storage. In addition, presence of sprouted wheat at high percentage (50%) improved bread flavor.

Anja Nicolodi is a food science and technology student at the University of Natural Resources and Life Sciences, Vienna. She is currently working on her master thesis at the University of Milan addressing the effects of sprouted cereals in traditional bread-making processes.

Investigation of the fermentation capacity of different *Saccharomyces cerevisiae* strains in bread dough

Eva Van der Maelen, Joran Verspreet, Mohammad Naser Rezaei and Christophe M. Courtin

Laboratory of Food Chemistry and Biochemistry and Leuven Food Science and Nutrition Research Centre (LFoRCe), KU Leuven, Kasteelpark Arenberg 20 box 2463, B-3001 Leuven, Belgium

eva.vandermaelen@biw.kuleuven.be

- Bread characteristics are partially determined by yeast strains
- Not all Saccharomyces cerevisiae strains show the same behavior in bread dough
- Yeast has an important influence on bread quality

Dough fermentation is without doubt one of the most important processes during bread making. In order to obtain sufficiently leavened bread, a proper fermentation capacity of the yeast used is required. Saccharomyces cerevisiae, often referred to as baker's yeast, produces not only sufficient CO_2 for the dough rise, but also has an impact on rheology, texture and flavor of dough and bread.

Thousands of genetically different strains of *Saccharomyces cerevisiae* exist and have applications in many different industries besides bread making e.g. brewery, wine making, bio-ethanol production, production of spirits,… Each strain has its specific fermentation capacity and this diversity can be exploited to improve bread quality. In this context, not only the typical baker's yeast strains but also other Saccharomyces cerevisiae strains enter the picture. A good comprehension of the behavior of those strains in bread and the way they affect the bread making process and its final quality becomes essential. This includes screening of the fermentation rate of several yeast strains in dough and examination of the impact of wheat flour constituents and dough ingredients thereon.

Eva Van der Maelen is a PhD-student at the University of Leuven, Belgium. She holds a Master degree in Bio-Science Engineering with a focus on food technology. After her graduation in 2014, she started her PhD on the fermentation behavior of different Saccharomyces cerevisiae strains in bread dough at the Laboratory of Food Chemistry and Biochemistry under supervision of Prof. Christophe Courtin. This laboratory mainly concentrates its efforts on cereal constituents and how they influence food production and quality, and is a member of the Leuven Food Science and Nutrition Research Centre (LFoRCe).

Influence of sourdough type and quantity on gluten quality parameters measured by Gluten Peak Tester following a correlation analysis on bread quality parameters

Mareile Heitmann, Emanuele Zannini, Elke K. Arendt

School of Food and Nutritional Sciences, University College Cork, Cork, Ireland

m.heitmann@umail.ucc.ie

- Organic acids are decreasing mixing time and weakening the dough
- Negative correlation of -0.76 ($p<0.001$) among acid concentration and torque maximum
- Acceptable Pearson correlations between GPT results and specific volume

A new approach to predict the gluten quality is the sensitive and rapid Gluten Peak Tester (GPT) which was recently introduced by Brabender®. This Study investigated differences in gluten network development time and strength by incorporating different ingredients into a bread dough formulation using the GPT. The GPT applies a shear-based method to evaluate gluten network formation. Ingredients including salt (2.2%), fat (1%), yeast (2%) and sourdough from various sources and amounts (1-20%), were used. By studying the effect of different ingredients on physical dough properties, organic acids substantially decreased mixing time and weakened the dough. The amount of acids gave a negative correlation of -0.76 ($p<0.001$) with the maximum torque. Major changes in gluten network development were observed when liquid sourdoughs were used in comparison to freeze dried sourdoughs. Good correlations could be found between the Gluten Peak Tester results and the bread specific volume between 0.470, $p<0.077$ and -0.922, $p<0.001$. The Gluten Peak Tester offers a fast opportunity for bakers to adapt their mixing process considering the influence single ingredients have on dough development time and strength to ensure a good bread quality.

Mareile Heitmann studied Food Chemistry at Braunschweig University of Technology, Germany from 2007 until 2013. In her final thesis she analysed new secondary metabolites in chill haze by using HPLC with DA detection. After her studies she worked for 8 month on an industry based baking project in the group of Prof. Arendt. Currently she is doing her PhD at the School of Food and Nutritional Sciences, University College Cork. Her project is focused on the impact of different yeasts on wheat flour dough and bread.

Investigation of the Applicability of a Micro-Scale Baking Test in Wheat Quality Research

Renáta Németh - Ágnes Bánfalvi - András Csendes – Sándor Tömösközi Budapest

University of Technology and Economics, Department of Applied Biotechnology and Food Science, Szent Gellért tér 4. 1111 Budapest, Hungary

nemeth.renata90@gmail.com

- Reduced sample size
- Decreased analysis time
- Less labor-intensive
- Application in breeding programs

As rheological methods offer only a prediction about end-product quality and they are mostly specified for (white) wheat flour, in some cases end product tests are necessary for the evaluation of product quality. Direct analysis of baking quality can only be performed by baking tests, which enables the determination of quite important parameters, e.g. bread volume, crumb structure and porosity, crumb to crust ratio, sensory properties, etc. One of the most important disadvantages of baking tests is their relatively large sample-size requirement. At the early stages of breeding and in R+D or product development, where sample size (e.g. raw material, additives, isolated or expressed proteins) is limited, micro-scale baking tests integrated with micro-scale sample preparation equipment and rheological instruments may allow a complex analysis and classification of cereals. However, the development of small-scale methods is a rather challenging task, especially for end-product tests. Since the development of the 2g-Mixograph, intensive research activities have been implemented to evaluate different micro scale apparatuses as well as studying the effects of the reduction of sample quantities on the measured parameters. So far, a family of micro-scale instruments has been developed at our department in cooperation with Hungarian and Australian colleagues: e.g. a micro-mill, a micro-sieve, a prototype of a Farinograph/Valorigraph-type micro-Z-arm mixer, etc. The aim of this study was to develop a micro-scale bread making method based on literature trials and to compare the results with a standard baking test using eleven winter wheat cultivars. In order to determine the minimal possible sample size and its comparability with larger sample sizes, loaf volume, height and sensory properties of breads were measured and investigated. Other rheological properties and indirect quality parameters, e.g. farinograph, alveograph and viscosity values, Zeleny-index, falling number, etc. were also determined and correlated with loaf parameters. Results showed that micro-scale baking can be a valuable tool for laboratory research, with even the crumble quality showing comparable results with the conventional method. However the micro-scale method was not able to differentiate the investigated wheat varieties, indicating the necessity of further method development or the investigation of the boundaries of sample size reduction.

This work is connected to the scientific program of the "Improving gluten-free dough by a novel hemicellulose network" project (OTKA-ANN 114554) and it was supported by the applied research project titled "Quality characterization and applicability study in market- oriented breeding of old wheat genotypes" (AGR_PIAC-13- 2013-0074).

Renáta Németh is a PhD Student at the Budapest University of Technology and Economics and a member of the Research Group of Cereal Science and Food Quality at the Department of Applied Biotechnology and Food Science. She graduated in 2015 with a Master's degree in Biochemical Engineering specialized in Food Quality Control. Her research fields are partly instrument and method development, on the other hand rheological measurements of cereal meals. Furthermore, her PhD work is strongly related to the investigation of non-starch polysaccharides in cereals and pseudocereals and to the development of gluten-free bakery products.

Development of a LC-MS/MS Method to quantify Puroindolines in Wheat Grain

Claudia Vogel, Peter Koehler

Deutsche Forschungsanstalt für Lebensmittelchemie, Leibniz Institut,
Lise-Meitner-Str. 34, 85354 Freising, Germany

Claudia.Vogel@lrz.tum.de

- Grain hardness is determined by tightly linked Puroindoline genes, Pin a & Pin b
- Isolation from wheat grain by Triton-X114 phase partioning
- Enzymatic digestion with trypsin after reduction and alkylation
- Identification of specific fragments/marker peptides for PIN a by LC-MS and ion trap

The main classes of wheat (*Triticum aestivum* L.) have "soft" and "hard" endosperm textures. Friabilin, a marker protein for grain softness (Ha) consists of the two proteins puroindoline a and b (PIN a and PIN b). These proteins have similar molecular masses of 13 kDa and are located on the surface of starch granules. Furthermore, puroindolines are lipid-binding proteins that are thought to improve the structure of breadcrumb and bread volume as well as the formation and stability of dough foams. PIN a and PIN b are basic, cysteine-rich proteins, with a unique tryptophan-rich domain. The aim of this study is to develop a practicable LC-MS/MS method to quantify puroindolines in wheat.

Puroindolines were extracted from flour of two wheat varieties differing in endosperm hardness by triton X-114, a non-ionic detergent. Triton X-114 is homogeneous at 0°C but separates into an aqueous phase and a detergent phase above 20°C. During phase separation, hydrophilic proteins were dissolved only in the aqueous phase, and membrane proteins including puroindolines with an amphiphilic nature were found in the detergent phase. SDS-PAGE (non-reducing conditions) showed a band of high intensity at a molecular mass of about 13 kDa that confirmed the presence of puroindolines. After extraction, the protein pellets were reduced with Tris(2-carboxyethyl)phosphine (TCEP) under nitrogen atmosphere. After reduction and subsequent labelling with iodoacetamide (IDAM) under nitrogen atmosphere, the puroindolines were digested with TPCK-treated trypsin and the resulting peptides were purified by solid phase extraction on Strata-X-C. The subsequent measurements at LC-MS/MS were performed on an UltiMate 3000 HPLC (Dionex, Germany) coupled with a HCT-Ultra PTM ion trap MS with CID (Bruker Daltonics, Germany). MS/MS data were analysed by using the MS/MS ions search module of Mascot software based on NCBI database (National Library of Medicine, USA). Four marker peptides for puroindoline a (*T. aestivum*, variety "Akteur") were identified (CNQGPPCNIPGTIG; LMQMPPQCR; GGCQELLGECCSR; DVAGGGGAQQCPVETK). Work on identifying marker peptides for puroindoline b from the second wheat variety is currently in progress. The marker peptides will be used to set up a stable isotope dilution assay for puroindoline quantitation in wheat. Once established, the analysis will provide quantitative data for puroindolines in different wheat varieties. These data might be useful to establish correlations between puroindoline concentration and baking quality of wheat.

Claudia Vogel is a PhD student at the Deutsche Forschungsanstalt für Lebensmittelchemie, Freising, Germany. She holds a Diploma and a state-approved Certification in Food Chemistry. Claudia is studying modifications of wheat proteins induced by processing. Specific aims of her work are the development of methods to determine the degree of denaturation of wheat gluten and to quantitate the concentration of puroindolines. Claudia has working experience as a team leader in an analytical laboratory for pesticides and contaminants in a successful global company.

Structural characterization of cereal-based oligosaccharides by MS/MS

Juvonen Minna, Kotiranta Markus, Jokela Jouni, Tuomainen Päivi, Tenkanen Maija

Department of Food and Environmental Sciences, University of Helsinki

minna.juvonen@helsinki.fi

- Two methods for structural analysis of neutral oligosaccharides by MS/MS
- Analysis of native and derivatized branched arabinoxylooligosaccharides
- Linkage position determination of linear structures
- Sequencing and characterization of branched unit

Tandem mass spectrometry (MS/MS) is an analytical technique for the identification and structural characterization of compounds. In tandem mass spectrometry the analyte is first ionized and then fragmented to the product ions. The product ion spectra will tell about the structure of the analyte. In this presentation two methods to analyze branched oligosaccharides by MS/MS will be introduced.

The studied samples were arabinoxylooligosaccharides (AXOs) extracted from the cereal arabinoxylan hydrolysates. Arabinoxylan is a common plant cell wall polysaccharide. In cereal grains arabinoxylan is structured by β(1→4)-linked xylopyranosyl residue backbone which is usually mono- or disubstituted by α(1→2)- and α(1→3)-linked arabinofuranosyl residues, but also β-D-Xylp-(1→2)-α-L-Araf-(1→3)-substituents and acidic (Me-4-O)-α-D-GlcAp-(1→2)-substituents has been found. The neutral AXOs were extracted from wheat, oat and rye arabinoxylan by enzymatic hydrolysis. The fractionated and isolated AXOs were identified with HPAEC-PAD, MS and NMR. Then nine AXOs with different branches and linkage positions and three commercial xylooligosaccharides were analyzed by MS/MS.

At first the AXOs were analyzed by a negative ionization MS/MS using ammonium chloride for the adduct ion formation. All the samples produced different kind of spectrum on MS^2 stage and can be identified by the spectrum in future studies. The linear AXOs samples were found to fragment from reducing end towards the terminal end. The linkage positions of linear structures could be identified by produced cross ring fragment ion patterns. The monosubstituted AXOs were observed to lack the cross ring fragments at the m/z range of the branched unit. The disubstituted AXOs did produce ions on a range that refers to the fragmentation of the branched unit. These ions were most likely formed by co-fragmentation of the reducing and the terminal ends.

Next the AXOs were derivatized by reduction and permethylation and analyzed by using a positive ionization MS/MS. The sequence and the branching unit could be determined since the derivatization differentiated the masses of original reducing end and terminal ends. For linkage position determination the B-ions were fragmented in the MS^3 stage. The linear structures were observed to produce diagnostic cross ring fragment ions from the different linkages. The branched units did not produce these cross ring fragment ions.

Minna Juvonen is third year PhD student in University of Helsinki. Minna's doctoral thesis is focused on LC-MS methods for analyses of cereal-based oligosaccharides. She graduated in 2010 and worked as a project researcher in Food Chemistry Division before continuing her studies.

How to replace gluten functionality in gluten-free pasta? Traditional and novel technologies

Alessandra Marti

University of Milan, Department of Food, Nutritional and Environmental Sciences (DeFENS)

alessandra.marti@unimi.it

- Gluten free pasta
- Using texturing ingredients
- Thermal treatments
- Starch organization

Defining and optimizing the technological process for gluten-free (GF) products still represent a challenge for researchers and industry. As concerns pasta, the GF pasta currently on the market is still far from what the consumer is looking for, despite the great efforts made in the last few decades to obtain a product with sensory characteristics similar to those of durum wheat products. Several ingredients (modified starch, additives, texturing proteins, etc.) have been used as alternatives to gluten in order to create a starch-based network that can withstand the physical stresses of cooking and, at the same time, impart firmness to the cooked product. In this frame, different variations of noodle-making technology have been proposed to simplify the artisan process based on repeated heating and cooling steps on the intermediate product, which are difficult to control and monitor.

This presentation will present an overview on how to replace gluten functionality in GF pasta. Most studies refer to laboratory scale pasta-making, neglecting the issues associate with transfer to an industrial scale. Moreover, most of the work done so far adopt an empiric approach (that is, varying ingredients and processing conditions) as opposed to understanding the macromolecule organization associated with cooking quality. It is presented here evidence that improved understanding of the relationship between starch structure and processing conditions may help the industry to re-formulate and develop products with the desired texture as well as improved nutritional properties. In particular, the use of different thermal treatments, on their effect on the physical properties of GF flours, and on their impact on the structure and cooking behaviour of a GF pasta obtained without the use of additives (monoglicerides, etc.) will be presented. The presentation will focus on how different starch rearrangements - affecting GF pasta functionality - can be assessed by using a multidisciplinary approach that combines information related to ultrastructure, thermal properties, crystalline order, molecular size distribution, enzymatic susceptibility, and presence/absence of specific regions that are all relevant to the product's properties.

Alessandra Marti is an Assistant Professor at DeFENS, University of Milan. Her main research activity focuses on Cereal Chemistry and Technology, with particular interest for pasta technology and quality. She has also been involved in studies aimed at understanding the relation between processing, biopolymers interactions, and quality of cereal-based food products. She has authored 33 peer-reviewed articles and 5 book chapters, and has presented more than 50 communications at scientific meetings. She is an active member of the American Association of Cereal Chemists and the Italian Association of Cereal Science and Technology.

The Role of Buckwheat Flour in the Quality Determination of Gluten-Free Starch Bread

Hanne Masure, Ellen Fierens and Jan A. Delcour

KU Leuven, Faculty of Bioscience Engineering, Laboratory of Food Chemistry and Biochemistry and Leuven Food Science and Nutrition Research Centre (LFoRCe)

Hanne.masure@biw.kuleuven.be

Overall, the market for gluten-free foods, and thus also for gluten-free breads, grows. About 1% of the world population suffers from celiac disease and cannot consume wheat, rye, or barley based food products. Furthermore, people who suffer from non-celiac gluten sensitivity and an increasing number of people who avoid gluten as a result of their 'lifestyle choices' follow a gluten-free or gluten-poor diet. However, gluten-free breads often have poor organoleptic and nutritional quality. They are of low specific loaf volumes, have a dry and crumbly crumb and stale faster than wheat bread. Furthermore, in many instances they lack taste, mouthfeel and an acceptable color. In addition, excluding wheat and other gluten - containing cereals from the diet creates the risk of shortage of certain essential nutrients. Different ingredients and additives are used to improve the sensory and nutritional quality of gluten-free breads. Many recipes have been developed by 'trial-and-error' approaches without fully understanding the impact of individual ingredients or additives on bread quality. In our research, the influence of individual ingredients and additives on different parameters during the complete bread making process, from batter production to bread staling, is investigated using innovative techniques such as baking in an electrical resistance oven and low field proton nuclear magnetic resonance. In this presentation, the use of buckwheat as a gluten-free starch bread ingredient was investigated. Buckwheat is a pseudocereal with good nutritional composition and a high dietary fiber content. The recipe for control starch bread was kept as simple as possible, with only cassava and potato starches, egg white, yeast, sugar, salt and water as ingredients. Substitution of 30% starch-egg white mixture by buckwheat flour changed neither the specific bread volume nor the textural parameters after cooling. Also, buckwheat addition did not alter amylopectin retrogradation enthalpy during six days storage. However, the rate of crumb hardening during storage decreased. Differences in water (re)distribution between both recipes were observed in fresh bread crumb and maintained during storage. Addition of buckwheat flour can thus prolong the shelf-life of gluten-free starch bread. Water distribution appears to play an important role in the mechanism of gluten-free bread staling.

Hanne Masure is a PhD-student at the University of Leuven, Belgium. She holds a Master degree in Bio-Science Engineering with a focus on food technology. After her graduation in 2014, she started her PhD on the role of different ingredients in the quality of gluten-free bread at the Laboratory of Food Chemistry and Biochemistry under supervision of Prof. Jan Delcour. This laboratory mainly concentrates its efforts on cereal constituents and how they influence food production and quality, and is a member of the Leuven Food Science and Nutrition Research Centre (LFoRCe).

Aroma profiles of different gluten-free doughs and crumbs

Joana Pico[a], José Bernal[a], José Luis Bernal[a], Manuel Gómez[b]

[a]I.U.Cinquima, Analytical Chemistry Group, University of Valladolid, Valladolid (Spain)
[b]Technical School of Agricultural Engineering, Food Technology Area, University of Valladolid, Palencia (Spain)

joana.pico@uva.es

- Gluten-free dough and crumb volatile profiles.
- SHS-GC/MS analyses.
- Breads made 100% with 12 gluten-free flours and starches (not mixtures).
- Flours and starches seem to affect volatile's concentration.

Bread aroma is one of the first characteristics perceived by the human senses, crucial for the acceptance by customers. The most consumed breads have been prepared with wheat or rye flour, which give pleasant notes. However, it is well known that when the bread is elaborated with gluten-free flours, the sensory quality decreases in relation to that of traditional wheat. Celiac people can only consume gluten-free products, which means that they should eat breads with less attractive flavors. The aim of this research has been to understand how different gluten-free flours/starches (yellow and white corn, rice, oat, teff, buckwheat, amaranth and quinoa flours and wheat, corn and potato starches) affect the generation of volatile compounds in the corresponding fermented doughs and crumbs. Volatile compounds were analyzed by static headspace - gas chromatography / mass spectrometry (SHS-GC/MS). Nine fermentation and lipid oxidation volatile compounds were evaluated, which were found the same from dough to crumb but in different amounts. Concentrations of compounds from fermentation were higher in dough whereas those from lipid oxidation were higher in crumb. It was also observed that the type of flour/starch only affects the concentration of the volatile compounds. Ethanol and 2/3-methylbutanol contents were higher in both corns, rice and oat dough and in quinoa and amaranth crumbs while hexanal, 1-pentanol and 2,4-decadienal contents were higher in starches doughs and in both corn crumbs.

Joana Pico is a PhD Candidate in Chemistry at the University of Valladolid, holding a contract to develop the PhD research since 2013. She did her BSc in Chemistry and her Master degree in Analytical Chemistry at the University of Valladolid, holding a researching fellowship in the last year of the BSc (in liquid chromatography, HPLC) and also during the Master degree (in gas chromatography, GC). She had two researching grants to collaborate with the Food Technology Area of the University of Valladolid before starting with the PhD, working firstly with the first one with HPAEC-PAD and with the second one with rheology techniques. Since 2012 she has been working with gas chromatography-mass spectrometry in Food Chemistry Area, focusing since 2013 on bread aroma analyses. Along her PhD, she has established partnerships with Food Technology Area of the University of Valladolid related to bread aroma. In 2015 she obtained a fellowship from the University of Valladolid to do a research stay at the University of Copenhagen (Food Science Department) during three months, working with gluten-free breads aroma.

Applications of Ethiopian Tef varieties in formulation of high nutritional profile gluten-free breads

Marina Villanueva[1], Julia Varas[1], Workineh Abebe[2], and Felicidad Ronda[1]

[1]Department of Agriculture and Forestry Engineering, University of Valladolid, Avda. Madrid 44, 34004, Palencia, Spain
[2]Ethiopian Institute of Agricultural Research. P.O.Box 2003, Addis Ababa, Ethiopia

mvillanueva@iaf.uva.es

- Alternatives and innovation in gluten-free breads
- Nutritional quality improvements for bakery products
- Gluten-free baking performance of different tef varieties

With the constant search for diversity and innovation in foods, an alternative niche market for nutrient-dense fermented baked goods has emerged to satisfy the interest of health conscious people diet, which became the dietary needs of a significant part of the world human population. Tef (Eragrostis tef) is a nutritious gluten-free (GF) cereal from Ethiopia, rich in carbohydrates and fiber, microelements and phytochemicals that contain superior amounts of iron, calcium and zinc than common cereals like wheat, barley and sorghum. Hence, recently tef is being considered as a good candidate for designing innovative functional foods for health promotion and disease prevention and its demand and consumption is increasing in several developed countries.

However, exploring the suitability of different tef varieties for bread formulation could be useful since most physicochemical, functional and nutritional properties of cereal-based goods are variety dependent. Therefore, the purpose of this study was to explore the suitability of three Ethiopian grain tef varieties (DZ-01-99 (brown grain tef), DZ-Cr-37 (white grain tef) and DZ-Cr-387 (Quncho, white grain tef)) in GF breadmaking. Corn starch was used to replace portions of tef flour in GF breads at different levels (0, 25, and 50%) and their physicochemical and sensory characteristics were evaluated.

Flours from the three tef Ethiopian varieties (DZ-01-99, DZ-Cr-37 and DZ-Cr-387) yielded technologically viable GF breads with adequate sensorial characteristics and high nutritional value. Incorporation of corn starch improved volume and reduced crumb firmness as compared with 100% tef flour breads and these effects were dependent on corn starch addition level and tef variety type. As expected, compared to breads from white tef flour breads from brown tef exhibited low crust and crumb hue. Markedly higher amounts of micro-elements (Ca, Cu, Fe, K, Mg, Mn and P) were measured in the GF breads from the tef flours than other common cereals used in bakery products. In conclusion, tef flour can be used to improve nutritional values of gluten-free breads and partial replacement by corn starch improved bread physical properties.

My name is Marina Villanueva and currently I am a PhD student at the University of Valladolid, Spain. I obtained BSc degree in Agricultural Engineering and then I continued my studies to obtain MSc degree in Food Quality, Development and Innovation from the University of Valladolid. I was also granted a scholarship to collaborate in research tasks in the field of cereal science at the Food Technology Area of the same university. Subsequently, I started my PhD study in the same area. My research topic is evaluating of the impact of acidification on starch-protein interactions and its structuring effect gluten-free systems. In line with this some of my research works have already been published in international journals with high impact factor.

Imitation of wheat dough by a synthetic polymer-based medium to investigate gas forming and holding capacity

Silvia Brandner, M. Jekle, T. Becker

Technical University of Munich, Institute of Brewing and Beverage Technology, Research Group Cereal Process Engineering

silvia.brandner@tum.de

- Imitation of wheat dough by polymer systems
- Investigation of gas retention in dough systems
- Detection of structure-function relationship
- Influence of CO_2 production kinetics and secondary metabolites on structure

The leavening of dough during processing is an essential requirement to ensure desired textural properties of baked goods. Therefore, the gas forming and holding capacity during fermentation and baking play a crucial role.

Many factors such as type and quantity of proteins, gas release kinetics, enzymatic and microbial activities and the presence of additives influence the extent of gas forming and retention. Intrinsically, the large number of influencing factors complicate the investigation of important structural elements. In addition, wheat dough properties differ because of raw material fluctuations and processing times. This fact complicates the establishment of a reproducible test standard.

An imitation of the wheat dough structure by polymer-based systems represent an innovative approach. Based on natural and synthetic polymer blends, the rheological behaviour of wheat dough can be imitated on a functional level. Therefore, the viscoelastic behaviour of different structures were analysed in a rotational rheometer. This offered the opportunity to simulate different processing steps by appropriate stress types (oscillation/rotation/deformation) and intensities. The recording of angular displacement - velocity and torque in combination with various mechanical models (Power Law/Burger Model) enabled an identification of key material properties.

It turned out that a combination of the natural polymer hydroxypropylcellulose with the synthetic polyvinylpyrrolidone was particularly suitable to simulate the viscoelastic behaviour of wheat dough over a wide frequency range. This artificial dough system offers the advantage of a constant material behaviour without enzymatic activity and therefore represents a constant test standard. Chemical leavening agents were used to observe the effect of gas release on the network structure. Additionally, CO_2 forming capacity and the metabolism of yeast can be investigated depending on dough-like viscosity.

In conclusion, this approach provides a new way to decipher essential structural elements for gas retention and dependencies of CO_2 forming capacity of yeast in network structures such as wheat dough.

Silvia Brandner has a Master's degree in Food Technology at the Technical University of Munich. Currently, she works as a PhD student at the Institute of Brewing and Beverage Technology, where she focuses on the investigation of structural modifications in wheat dough systems during proofing.

Role of Ingredient Interactions on Structural and Physycal Characteristics of Cake Batter

N. Hesso[a,b,c,d], P. Le-Bail[c,e], C. Loisel[a,b,c], S. Chevallier[a,b,c], A. Marti[d,f] , K. Seetharaman[g] & A. Le-Bail[a,b,c]

[a]ONIRIS, GPA, BP 82225, 44322 Nantes, France; [b]LUNAM Université Nantes Angers Le Mans, UMR 6144 GEPEA CNRS, 44307 Nantes, France; [c]SFR 4204, Ingénierie des Biopolymères pour la Structuration de Matrices et des Matériaux (IBSM), 44316 Nantes, France; [d]Department of food science and nutrition, University of Minnesota, Saint Paul 55108, MN USA; [e]INRA, UR 1268, Biopolymères Interactions Assemblages, Rue de la Géraudière, BP 71627, F-44316 Nantes cedex 3, France; [f]Department of Food, Environmental and Nutritional Sciences, University of Milan, via G. Celoria 2, 20133 Milan, Italy; [g]Deceased; formerly Department of Food Science and Nutrition, University of Minnesota, Saint Paul 55108, MN, USA

- Role of ingredients interactions on batter/cake structure
- Fat importance on proteins conformation
- Compition on water during baking
- Starch and protein gel in cell wall material

Cake batter is a dispersion of macromolecular biopolymers. Starch and proteins play a key role in determining the structure, the rheology and other physical properties, as well as the sensory perception of the finished product. Furthermore, the texture of the cake depends on the formulation, the aeration of batter, the batter-crumb transition and its stability after baking. To control the quality of this finished product, it is essential to understand the effects of the ingredients on batter properties during mixing and baking.

This work is devoted to investigate the effect of interactions of the ingredients on protein and starch features. Protein secondary structure and hydrophobicity were evaluated by Attenuated total reflectance-Fourier Transform Infrared (ATR-FTIR) and Fluorescence (FS) spectroscopies, respectively. Regarding starch, thermal and pasting properties were investigated by differential scanning calorimetry (DSC) and MicoViscoAmylograph (MVAG), respectively. The work was done on both model and real batter systems.

ATR-FTIR spectra showed that fat addition greatly affected protein conformation, and specifically alpha-helix structures, rather than the other ingredients (e.g eggs, sugar, pregelatinized starch). This result shows the importance of the fat-proteins interactions that could result in a poor development of the protein network by increasing alpha-helix structures. FS results showed that the changes in protein hydophobicity, in the final model system (batter),was more related to egg and sugar addition rather than to the other ingredients such as the fat. These changes are related to the exposure of tryptophan to more hydrophobic environment by egg and sugar presence. During baking, interactions among ingredients affected the melting point of fat, the denaturation of proteins and batter-crumb transition that moves towards higher temperatures, as determined by DSC. Finally, during cooling, the formation of the starch and proteins gel measured by MVAG controlled the final viscosity reached during cooling which contributes to the texture of the material of the cell wall of the finished product. This confirms that starch and proteins play an important role in the final structure of the finished product.

In conclusion, this work highlited the impact of fat on protein conformation in batter. While the competition between ingredients on water controlled phase transitions during cake batter baking which is fundamental to explain batter-crumb transition and consquently the finished product quality.

Nesrin HESSO is Research Ingeneer at UMR GEPEA, ONIRIS, Nantes, FRANCE on baking process. She holds a PhD since decembre 2014 in Food process engineering from ONIRIS. She undertook reaserch duties during her PhD with different partners as INRA Nantes (France) and University of Minnesota (USA). She was also selected is invited PhD student to Brazil as part of an international program (Seminar Advances in Molecular Structuring of Food Materials - University of São Paulo, Brazil). Nesrin is working on different industrial contracts with a mission of project manager and coaching master level trainees, conducting tests in laboratory and industrial levels. She is a member of AACCI for the past 3 years.

Influence of mechanical stress on starch structure and functionality

Sabina Jakobi, Mario Jekle, Thomas Becker

Technical University of Munich, Institute of Brewing and Beverage Technology,
Research Group Cereal Process Engineering, Freising, Germany

sabina.jakobi@tum.de

- Producing flours with special properties
- Affecting bread volume, crust color, texture, staling
- Influencing quality of bakery products

Milling of grains leads to structural changes of starch granules, which cause variations regarding the technological functionality of the resulting flour and dough. Thereby, the extent of mechanical starch modification depends on milling parameters, such as type and quantity of the shear forces. The objective of the present study was to fill gaps in knowledge by examining the influence of structural starch modifications on dough properties and baking performance.

Thus, an ultra-centrifugal mill was used to induce different degrees of starch modification, which were analyzed amperometrically. For this purpose, rotation velocities varied from 0 to 18000 rpm and mesh sizes ranged between 80 and 1000 µm. In order to determine the molecular impact of the milling stress, HPAEC and dynamic light scattering were employed and supported by MALDI-TOF. The water retention capacity and baking performance of the modified flours were investigated to reveal structure-function relationships.

Commercially available wheat flour contained 5.5 ± 0.0% modified starch, which was elevated to 7.9 ± 0.0% by additional ultra-centrifugal milling at 18 000 rpm (80 µm mesh size). Thereby, the maltose content of the flour (4.6 ± 0.6 to 28.5 ± 0.6 mg/g flour) was related to the rotation speed. Furthermore, at high rotation velocities the particle size ($d_{1;0.5}$) decreased from 3.9 µm to 3.3 µm, while the water retention capacity increased in a linear way with a rising degree of starch damage ($R^2 = 0.87$).

Differences in bread volume were compensated by adjusting the water addition with a DoughLab. However, bread with modified flour had reduced crumb firmness after baking and especially during storage. Both, a higher water addition and an extension of the shelf-life might provide economic benefits for the baking industry. In conclusion, insights into starch modification mechanisms might be helpful to reduce other raw material fluctuations and mechanically modified starch might serve as a clean-label functional additive.

Sabina Jakobi studied at the University of Hohenheim and holds a M.Sc. degree in Food Science and Engineering. She currently aims for a doctoral degree at the Institue of Brewing and Beverage Technology at the Technical University of Munich, where she works as a Research Associate. She focusses on the impact of mechanical forces on starch granules structures and the resulting changes of the flour functionality.

Effect of the inclusion of different soluble and insoluble fibres on sugar-snap cookie quality

Camino Martínez Mancebo, Patricia Rodríguez, Mario M. Martínez, Manuel Gómez

Food Technology Area, College of Agricultural Engineering, University of Valladolid, 34004 Palencia, Spain

caminommancebo@gmail.com

- High fibre inclusion levels in sugar-snap cookies
- Increase in nutrition
- Soluble and insoluble fibres could counteract the effect of each other

Cookies are a baked product, characterized by having low final water contents, generally containing as three major ingredients flour, sugar and fat. It is widely known that fibre consumption provides better control of blood glucose and cholesterol levels, protection against cardiovascular diseases, regulation of intestinal function, promotion of gut health and reduction in risk of colon cancer. There are several studies analyzing the incorporation of different fibres on fibre-rich cookies. However there is not a systematic study which analyses and compares the effect of adding different types of fibre, regarding their solubility (soluble and insoluble) and its shape and size, on the quality of cookies. Therefore, the aim of this study was to investigate the effect of the incorporation of different soluble and insoluble fibres on sugar-snap cookie quality. Insoluble fibres, (bamboo, fine and coarse, potato and pea), mainly composed by cellulose, and soluble fibres (Nutriose®, polidextrose and inuline) were studied. Bamboo fibres are long fibres whereas potato and pea fibres are more rounded.

The incorporation of insoluble fibre increased the dough consistency in all cases, while the soluble fibre had the opposite effect. It was found a relationship between dough rheology and the diameter and the spread factor of cookies, in such a way the higher consistency the lower spread factor and therefore the lower cookie diameter. Therefore, soluble fibre incorporation decreased dough consistency, promoting the spread during baking and giving rise to thicker cookies, lower luminous and with higher a* values than control (without fibre). Meanwhile, insoluble fibre formed cookies with lower diameter and spread factor than control. However, significant differences in quality parameters of cookies regarding the fibre shape were not found. Results showed that particle size affected cookie dimensions, since coarse fibres gave rise to cookies with lower spread factor. Every fibre increased the cookie hardness, although this effect was more remarkable in the case of insoluble fibre and especially in the coarsest ones. These opposite trends could suggest that a combination soluble and insoluble fibres could give rise cookies with higher fibre content without affecting the cookie dimensions, but increasing progressively their hardness.

Camino Martínez is a PhD student at the University of Valladolid. She holds a BSc.Honours in Agronomy Degree and she is currently in the third year of her thesis. Her thesis topic is "The improvement of gluten-free bread and sugar-snap cookies: changes in dough rheology and product quality". Over the years she has published four scientific articles related to her thesis. In her last study, she is trying to increase the fibre content in sugar-snap cookies by adding soluble and insoluble fibres without decreasing the cookie quality.

Including buckwheat bran in wheat dough and bread: what happens?

Miriam Zanoletti[1,2], M. Ambrogina Pagani[1], Stefano Renzetti[2]

[1]University of Milan, Department of Food, Environmental and Nutritional Sciences, Milan, Italy
[2]TNO, Expertise group Functional Ingredients, Zeist, The Netherlands

miriam.zanoletti@unimi.it

- DMTA and DSC allowed evaluating the effects of buckwheat bran addition on the thermo-mechanical transitions during processing
- At similar composition of buckwheat bran, variations in particle size resulted in distinct effects on dough thermo-mechanical properties and bread quality
- The Ashby-Gibson theory for cellular solid foods allowed to reveal the influence of bran on the mechanical properties of the solid crumb matrix

Development of products rich in ingredients with high nutritional value –as dietary fiber– is currently one of the most important goals for food companies. However, inclusion of high levels of fiber in cereal-based products is still technologically challenging, as for the texture and the sensory quality. Buckwheat is a nutritionally-relevant pseudo-cereal and is traditionally used in Europe and Asia for pasta production, but rarely exploited in bakery applications.

In this study, we investigated the effects of enriching wheat flour with increasing levels of buckwheat bran (5, 10, 20%), before and after micronization.
DMTA and DSC allowed evaluating the effects of bran on the thermo-mechanical transition during processing while dough rheology at large deformations was assessed by the Kieffer test. Standard baking tests and TPA were performed on bread.

Regarding dough properties, both DMTA and DSC showed that bran enrichment resulted in increase in the temperature of starch gelatinization. The size of the effect depended on bran amount and particle size. DMTA also provided evidence as for changes in the viscoelastic behavior during heating. As for Kieffer test results, increasing bran inclusion led to a decrease of resistance to extension.

Concerning the baking quality, the decrease in loaf volume due to buckwheat enrichment clearly depended on the level of inclusion and on bran particle size. Moisture content of fresh bread reflected the behavior in dough hydration for both types of bran: gradual enrichment with buckwheat as such led to a more wet product, whereas the substitution level with micronized bran had no significant effect. Crumb firmness increased as the bran content increased and was positively correlated with crumb density. The Ahsby-Gibson theory for cellular solid was applied to correct for the effect of density. Bran as such increased the corrected hardness for addition level higher than 10%. On the contrary, micronized bran deeply altered crumb firmness already at 5% substitution level.

Overall, buckwheat bran greatly affected dough rheology and thermal transitions during baking, which resulted in considerable changes in bread quality. Such changes could be related not only to the enrichment degree but also to the size of the bran particles.

Miriam Zanoletti is a PhD student at the University of Milan. Her principle research interests relate to the molecular and rheological properties of cereal-based food matrices with a particular focus on the role of non-starch polysaccharides as functional ingredients. During her studies she spent a 7-months internship at TNO - Expertise group Functional Ingredients (Zeist, The Netherlands).

Production of bakery products added carob (locust bean)

Yüksel Özdemir[a], Kamuran Öztop[a], Sevcan İlhan[b]

[a]University of Toros, Bahçelievler Campus
[b]University of Mersin, Çiftlikköy Campus

kamuran.oztop@toros.edu.tr

- Powder obtained from carob (locust bean) syrup pulp
- Production of pogaca, cake, ice cream cone with added carob (locust bean) syrup pulp powder
- Properties of pogaca, cake, ice cream cone with added carob (locust bean) syrup pulp powder

Carob fruit is from the carob tree (*Ceratonia siliqua*) and is part of the legume family and native to the Mediterranean regions. The trees tend to grow well anywhere that citrus or olives can grow but prefer drier climates. Carob grows as long, slightly curved, thick, dark brown pods anywhere from 4-10 inches (10-25 cm) in length.

Carob fruit has high nutritional value due to having high amounts of carbonhydrates, minerals and compounds that has an antioxidant activity. Carob naturally contains polyphenols, which help with blood cholesterol levels in a way similar to dietary fiber. Dietary fiber helps lower cholesterol levels.

This fruit is consumed at the most by processing carob syrup in Turkey. Pulp is remaining after the production of carob syrup has the highest rate of dietary fiber, not converting to a commercial value used as livestock feed.

In this study, the daily food consumption of bakery products make up at least 50% of the adding pulp remaining of carob syrup and was gained the functional properties. Flour amounts is used in production of pogaca, cake, ice cream cone of rates 5%, 10% and 15% respectively and carob pulp powder was used instead of wheat flour. Quality characteristics of prepared the sample was determined.

According to these results, the formulations where the flour reduced by all results up 15% has the very similar results with the control sample in terms of the properties of dough and product quality.

Kamuran Öztop is a lecturer at the University of Toros. She teaches nutrition principles, food safety and hygiene, entrepreneurship courses. She graduated from Department of Food Engineering, University of Mersin in 2010. She completed master program at food chemistry. In her thesis; hazelnut protein concentrate was produced from grinded and defatted hazelnut. Functional properties of the hazelnut protein concentrate were determined.

Sprouted wheat as an alternative to conventional flour improvers

Gaetano Cardone[1], Anja Nicolodi[1,2], Maria Ambrogina Pagani[1], Alessandra Marti[1]

[1]Department of Food, Environmental and Nutritional Sciences (DeFENS), University of Milan
[2] Department of Department of Food Sciences and Technology, BOKU-University of Natural Resources and Life Sciences, Vienna, Austria

gaetano.cardone@unimi.it

- Wheat sprouting in controlled conditions
- Improvement of dough rheology and bread characteristics
- Alternative to conventional processing aid

Sprouting is a natural process, which can be exploited by food scientists and industries to improve the nutritional and sensory profile of cereal-based foods. Controlled sprouting of grains might lead to the development of specific enzymatic pattern (amylases, proteases, cellulases) that may improve cereals micronutrients bioavailability, color, taste and flavor, and eventually their bread baking performance. Nonetheless, the impact of sprouted grains on dough rheological properties has not been thoroughly investigated. The present work addressed the possibility of using sprouted wheat flour to improve the bread-making performance of "stiff" (P/L > 1) flours in place of conventional flour improvers (e.g. xylanase, malt). Xylanase and malt were added to the control flour at 0.5% level, as conventionally used in bakeries, whereas sprouted wheat flour was used at 1.5%. Adding xylanase, malt or sprouted wheat to control flour significantly decreased dough "stiffness", though best performances were observed in the presence of sprouted wheat. Unlikely the mixtures containing xylanase or malt, the 1.5% sprouted wheat blend showed a gluten aggregation strength similar to that of the control, suggesting no worsening of the protein network characteristics. As for the leavening properties, dough development was increased from 52.8 mm to 70.4 mm, thanks to the enrichment with sprouted flour. In addition, presence of sprouted wheat improved the amount of gas production during leavening. As for the pasting properties, addition of either malt or sprouted wheat led to a significant decrease in the paste viscosity and in the peak temperature, as a result of high amylase activity. Interestingly, in the presence of sprouted wheat lower setback values were observed, thus indicating a lower starch retrogradation tendency that might positively affect bread staling. In conclusion, addition of 1.5% sprouted wheat may represent a valid alternative to xylanase or malt for improving the rheological properties of "stiff" flours. Further works are ongoing to investigate the impact of other sprouted cereals and pseudocereals on dough performance and bread properties.

Gaetano Cardone is a Research Assistant at the University of Milan. He received a MS in Food Science and Technology at the University of Milan, carrying out experimental studies aimed at the physico-chemical and rheological characterization of weak wheat flours. He is currently addressing the effects of sprouted cereals and pseudo-cereals in traditional bread-making processes. He is planning to apply for a PhD student position in Food System.