

# Grains for feeding the world: the ICC/AISTEC conference on the occasion of the World EXPO Milan 2015

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## MEETING REPORT

### 1. Introduction

Grains and cereal grains in particular are a vital resource and a fundamental part of the human diet. Because of that, they play a major role in the food supply chain, and over the last decades the scientific cereals community has grown and has increasingly covered discussions on all scientific facets of this staple food. In July 2015, the Italian Association for Cereal Science and Technology (AISTEC), in collaboration with the International Association for Cereal Science and Technology (ICC), organised an international conference in Milan on the occasion of the 2015 EXPO, to attract worldwide scientists, regulators, industry representatives and supply chain stakeholders to discuss extensively and comprehensively how to use grains to feed the planet and what are the main characteristics and/or challenges to implement that. The discussion fell within the broader framework of the EXPO theme 'Feeding the planet, energy for life!'

The 10<sup>th</sup> AISTEC conference 'Grains for feeding the world', held at the University of Milan, 1-3 July 2015, brought together more than 180 participants from 19 countries (Austria, Brazil, Canada, China, Ethiopia, Philippines, France, Germany, Ireland, Italy, the Netherlands, Poland, Russia, Spain, Switzerland, Togo, Turkey, USA, and Zimbabwe), and was an opportunity to address novel aspects and major global challenges, such as limited agricultural land and resource scarcity, biodiversity, pressures of a changing climate, food security, safety, innovation in production and technology, health and nutrition as well as consumer needs, so as to help shaping the future of grains. The discussion of these topics was organised into eight scientific oral sessions and a poster session for a total of 183 presentations, with 45 speeches and 138 posters.

The conference provided a unique opportunity for both young and senior scientists and industry representatives for networking and exchanging knowledge about grains and derived products; it enabled a meeting of science, research, innovation and marketing. Our thanks go to the 10 exhibitors, i.e. Belotti Strumenti srl and Brabender, Bastak, Elementar, Perten Instruments, Propasta, Quinoa Felix, Radox Food Diagnostics, Romer Labs, Shimadzu and Varvello, that actively interacted with participants and contributed to the event with their table top exhibitions of products, equipment and scientific tools. A distinctive

feature of this conference was the global approach of handled topics, as well as a wide coverage of grain species from cereals to pseudo-cereals and legumes, in line with the vision of the chair of the scientific committee, Marina Carcea (CREA, Italy), and the other 37 members of the national and international scientific committees.

### 2. Welcome speeches

The welcome address was given by Marina Carcea who expressed her honour and pride to be the organiser of this international outstanding scientific event. Together with Fengcheng Wang, ICC president, she highlighted AISTEC and ICC commitment to furtherance of cereal science and technology both in Italy and around the globe, and pointed out that the event was also the occasion to celebrate the 20<sup>th</sup> and 60<sup>th</sup> anniversary of, respectively, AISTEC and ICC activity. Moreover, Francesco Bonomi, from the University of Milan (DeFENS, Italy), and Claudia Sorlini, EXPO representative, stressed the longstanding and renewed commitment of the two represented Institutions in the study and spreading of knowledge on cereals, pseudo-cereals, grains in general, as well as on health and nutrition.

### 3. Setting the scene (Session 1)

In Session 1, three authoritative invited speakers set the scene for the forthcoming discussion on how to feed the planet using grains, and they delivered outstanding lectures on three hot topics: (1) the relationship between the world food security issue and grain production, consumption and trade; (2) the importance of cereal crops and genetic diversity to cope with the multiple challenges of 21<sup>st</sup> century agriculture; and (3) the sustainability of diets without wheat and grains.

The first invited speaker of the day was Hervé Guyomard, scientific director for agriculture of INRA (France), who discussed the world food security issue with particular attention being given to the role of grain production, consumption and trade. By recalling the Food and Agriculture Organization's (FAO) definition of 'food security' in 1996, according to which food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life, he analysed why the perspectives for grains, in terms of security, are good. He highlighted that according to nearly all studies dealing with world food security, world agricultural production has to increase by around 60% to satisfy global demand in 2050, compared to production levels in 2006/2007, and explained that these figures imply an increase in crop yields, cropping intensity, but also a limited land expansion. He also stressed how the increased demand for grains is a result of the convergence of new eating patterns worldwide, and pointed out the extent to which research efforts are needed for a sustainable increase in the cereal supply chain in a context of climate global change.

Concern for cereal production was then expressed by Carlo Fadda (Bioversity International, Ethiopia). When population and economic growth call for an increase in cereals production between 70 and 100% by 2050, climate changes will certainly negatively impact on cereals' yields, and this is especially true for Africa. In addition, land is degraded in large parts of the continent and smallholder farmers lack resources and access to adequate technology. He stressed the importance of genetic diversity to increase crop yields and improve stress tolerance, and reported as an example durum wheat genetic diversity in Ethiopia. Fadda concluded that plant breeding is important to adapt agriculture to future climates. He also highlighted that significant changes in the way we produce, process, transport, market and consume foods, are required to improve diets and nutrition outcomes; he stressed that we need a new way of understanding food systems and that some types of diets have low environmental impact while addressing human nutrients needs. In conclusion the 'take home message' was that biodiversity is essential

for healthy, nutritious diets in the face of climate change and for creating resilient and sustainable food systems, and provides win-win opportunities to address malnutrition.

The last lecturer of the morning discussed a recently widespread recommendation in popular nutrition books for eliminating wheat, grains and, in some cases, carbohydrates from the diet, as it is nutritionally superior for optimal brain function, weight management and chronic disease prevention. Julie Miller Jones (Professor Emerita at St. Catherine University, USA) debated the deleterious influence of this statement, and stressed how these foods contribute important nutrients and play critical roles in metabolism and maintenance of homeostasis, beyond providing energy. In conclusion, she highlighted that putting carbohydrates and grain staples, especially wheat, under attack for being the main reason of rising rates of obesity and chronic diseases, actually fails to name the real problem in nutrition in several countries, that is excess calories. According to Julie Jones, whole-grain and bran-rich cereal and bread products are to be recommended, as they are rich in bran and other dietary fibres, as well as important nutrients and phytonutrients. Their consumption has been associated with lower risk of weight gain, type 2 diabetes, cardiovascular diseases and certain types of cancer.

### 4. Sustainability, economics and trading of grains (Sessions 2 and 3)

In the recent decades sustainability has increasingly become a key concept along the grain supply chain, and all stakeholders make every day great strides toward it. Industry, for instance, cares how raw materials are grown and works with local growers and processors to support sustainable agriculture practices to bring the best to consumers. Water consumption is carefully watched. Energy consumption and greenhouse gas emissions are reduced through several efforts. Sustainable ways of transporting ingredients are implemented so as to reduce carbon footprint a little more each year. Greater participation in recycling programs is encouraged so that packaging gets new life. It is therefore widely recognised that a more sustainable grain sector would preserve the environment (environmental sustainability) and allow also socio-economic sustainability. Sessions 2 and 3 offered participants an interesting insight into sustainability that was discussed in terms of diet, economics and trading, agronomy, process and supply chain.

Session 2, chaired by Hamit Köksel (ICC President Elect, Hacettepe University, Turkey) and Elisabetta Lupotto (CREA, Italy), started off with a speech by Gerard Kramer (Blonk Consultants, the Netherlands) on a software package for the optimisation of diets in terms of health and sustainability: Optimeal<sup>®</sup>. He highlighted how making food production and consumption more sustainable and

healthier is actually a global challenge nowadays, and stressed that defining healthy and sustainable food patterns should be actually based on a systematic investigation and sound data. The proposed Optimeal® programme is therefore, according to his experience, the tool that allows to identify, for sustainable diets, a balance between nutritive value and lifecycle environmental impact. In particular, he stressed an interesting outcome, applicable to grains: the software under consideration allows to observe a likely shift towards more whole grain types within the bread category in sustainable diets. Whole grain bread and crisp bread are eco-efficient sources of nutrients, more than meat and/or dairies, for instance.

Results of a test about whether the investing activity in the futures market of commodities, such as cereals and soybean, can be identified as a source of the increasing commodity prices, were presented by Marco Zuppiroli from the University of Parma (Italy). Francesca Galli (University of Pisa, Italy), on the other hand, presented the main outcomes of the GLAMUR project on the sustainability of global and local chains, applied in particular to bread production. She also stressed how geographical distance, resources and know-how, governance and territorial identity are important criteria that distinguish between local and global supply chains. Giovanni Cappelli (University of Milan, Italy) presented a pilot system to forecast rice yields and grain quality in Northern Italy, and to give timely in-season indications about rice cropping systems performance. He highlighted how this tool is likely to be used by farmers to elaborate qualitative variables influencing rice prices and/or methodological aspects, and also pointed out how crop quality is a crucial aspect in terms of economic value, end-use destination, and human and animal health.

Cesare Ronchi (Barilla Group, Italy) showcased a plan for crop rotation and a Decision Support System elaborated by Barilla to enhance the sustainability of durum wheat cultivation and the environmental impact, while keeping high standards of pasta quality and safety. He highlighted the use of environmental, agronomic and economic indicators to quantify the sustainability of the different cropping systems, and showed how the Decision Support System can be helpful for farmers in their decision, and can also significantly increase the production efficiency, reduce production costs and ease environmental impact.

Jorge Oliveira (University College Cork, Ireland) analysed the sustainability of rice processing. He highlighted the technologies and methodologies for process intensification, optimisation of energy and mass, as well as their applicability in rice milling and secondary processing. The last speech of Session 2 was delivered by Chantal Ekpetsi O Goto Bouka (Togolese Research Institute on Agronomic Research, Togo) who talked about the fortification of baby foods with local foodstuffs as a response to malnutrition in Togo. Within the

framework of a joint initiative by UNICEF and the Togolese Institute of Agronomic Research to fight malnutrition, fortification of baby foods was implemented by formulating a food with corn, sorghum, rice and soya, enriched with two local plants rich in vitamin and mineral salts that contribute to improving zinc, iron and protein content: *nééré* (*Parkia biglobosa*) and moringa (*Moringa oleifera*). O Goto Bouka highlighted the nutritional qualities of the new flours containing macro- and micro-nutrients useful in the deficiencies of proteins and micronutrients.

Session 3, chaired by Michaela Pichler (ICC, Austria) and Massimo Palumbo (CRA-ACM, Italy), was opened by Joel Abecassis (INRA, France) with a keynote lecture on reconsidering the organisation of the cereal chain for food and green chemistry. Abecassis pointed out that the different applications of cereals have led to multiple chains: food chains (milling, baking, etc.), feed industries, starch industry and more recently bio-fuels. All these sectors mobilise a range of different economic stakeholders that seek to maximise economic performances without taking into account opportunities for by-products. However, balance is hard to be reached as fluctuations inherent to agricultural production cause significant price distortions and severe local problems. Abecassis thus pointed out that an alternative might be a review of the organisation of the full cereal chain from production to final end-uses, so that each single supply chain can be optimised and the output of the entire system maximised. He also recommended a more holistic approach to be applied to the complex full cereal system, that combines a local and global perspective and is based on a reverse engineering, as well as the reorganisation of the cereal chains to better fulfill the different uses of cereal products.

Gabriele Chiodini (University of Perugia, Italy) presented the effects that the introduction of greening may have on durum wheat in Italy. Greening allows, in fact, a crop diversification with relevant effects on the farmer's income, since in some Italian rural areas economic and environmental factors influence crop selection. Chiara Nobili (ENEA UTAGRI-INN, Italy) highlighted how a low-input pseudo-cereal like buckwheat is suitable for sustainable agriculture. She stressed how tartary buckwheat can be successfully cultivated in mountainous marginal areas and its flours can be used to formulate healthy foods, from biscuits to crackers and pasta, with high antioxidant profile. The session was closed by Jelous Paul Muchineripi (Ministry of Trade and Commerce, Zimbabwe) who presented the Zimbabwean model for cultivation of finger millet as a case study proving how the promotion of finger millet as a staple grain can satisfy the FAO definition of food security and can help to feed the world.

## 5. Health and nutritional aspect of grains (Sessions 4 and 5)

Cereal grains are an important energy source, as well as a reservoir of macronutrients, cell wall polysaccharides (dietary fibre) and biologically active minor constituents that make these staple foods an important component of a health-promoting diet. Health potential and health effects of grain products are in fact well-known and if, on the one hand, food companies aim at improving the nutritional profile of cereal foods, on the other hand, research activities around the world emphasise the study of physiological mechanisms and cereal food factors leading to health protection, and the development of technologies suitable for a better exploitation of the grain in food products. In addition to research and industrial communities, regulatory bodies and public health actors have an important role in the process of improving the intake of protective nutrients, dietary fibre and bioactive compounds from cereal foods.

Within this framework, two technical Sessions were scheduled for the second Conference day to analyse and debate the relationship between grains and health and nutrition. Session 4, chaired by Julie Miller Jones (St. Catherine University, USA) and Francesco Bonomi (University of Milan, Italy), started off with a keynote lecture by Anthony Fardet (INRA, France) on the association between grain products and chronic disease risks. After discussing a new philosophy of preventive nutrition, shifting from a reductionist to a holistic approach to improve nutritional recommendations, the French expert concluded that grain products are protective and evidence can be brought on their protective effects against diseases like overweight and obesity, type 2 diabetes, cardiovascular diseases and cancer. He also stressed that no studies have so far ever revealed a deleterious effect on human health and that cereals are more protective than fruits and vegetables. Laura Gazza (CRA-QCE, Italy) talked about einkorn wheat (*Triticum monococcum* L.) that is being investigated as a cereal with reduced or null toxicity for individuals with coeliac disease. She stressed in particular the remarkable differences in coeliac disease toxicity amongst einkorn genotypes with different composition in prolamins, proteins that constitute the gluten macromolecules. In particular, she pointed out that an immunoreactive peptide, belonging to the  $\omega$ -gliadin family, was found in thirteen accessions and showed to have a potential anti-inflammatory activity in coeliac disease. Giuseppe Perretti (University of Perugia, Italy) reported the main outcomes of experimental investigations on the nutritional effects of alcoholic vs non-alcoholic beer, in particular, their effects on the antioxidant capacity of plasma. He pointed out, in particular, that the consumption of reduced alcohol beer may give health benefits. Pigmented rice, phytochemical profile thereof and the effect of cooking on it were the topics addressed by Valentina Melini (CRA-NUT, Italy). The young

scientist highlighted the unique phytochemical profile of some Italian pigmented rice varieties, the importance of the chosen rice-cooking technique on preserving their phytochemicals content, as well as the bioactive compounds that are more resistant to cooking. Indeed, she stressed that although rice phytochemical content decreases after cooking, some pigmented rice varieties preserve an appreciable amount of phytochemicals, similar to other foods. Nicoletta Pellegrini (University of Parma, Italy) talked about the health effect on blood metabolic and inflammatory disease markers of healthy overweight/obese volunteers with low intake of fruit and vegetables and sedentary lifestyle of an innovative whole grain pasta, enriched in barley  $\beta$ -glucans and *Bacillus coagulans* spores. In particular, she stressed that consumption of this innovative pasta improves some markers linked to the risk of cardiovascular events and this effect was probably related to the functional ingredients added to the pasta. Moreover, an improvement of the glucose metabolism was observed when volunteers consumed this innovative pasta. The last presenter of the session was Miriam Zanoletti (University of Milan, Italy) with a speech on the screening of maize germplasm for nutritional and technological parameters. Zanoletti highlighted that following the spreading of gluten intolerance or coeliac disease among consumers, larger amounts of maize should be introduced in diets, being it a gluten-free cereal. The characteristics that mainly contribute to the identification of the most suitable raw materials for nutritional benefits and technological use are thus to be increasingly identified. The study involved genotypes of a certain set of maize inbreds, screened in specific breeding programs.

Fred Brouns (Maastricht University, the Netherlands) opened Session 5, chaired by Jan Willem van der Kamp (TNO Food and Nutrition, the Netherlands) and Norberto Pogna (formerly CRA-QCE, Italy), and delivered a keynote lecture on the idea of establishing a task force to counteract the current issue among social media that carbohydrates are bad and wheat makes you sick. As this statement is more and more leading to global falls in breakfast cereals, pasta and bread consumption, Brouns advertised a global research and communication project addressing wheat/gluten avoidance and consumers well-being, coordinated within HealthGrain Forum Europe, in direct collaboration with ICC and possibly with the American Association of Cereal Chemists International. He stated that according to available data, only 1% of the population is actually diagnosed for wheat intolerance-coeliac disease; <1% suffers from wheat intolerance-allergy and another 6-7% may claim to suffer from non-coeliac gluten sensitivity and non-coeliac wheat sensitivity. However, depending on region-country 15->50% of the population asks for wheat/gluten free foods and this has led to a significant fall in wheat/cereal based foods consumption in many countries. Rebutting this trend, Brouns launched a call for a joint venture within the cereal

grain scientific community to prove the important health effects cereals and grains in general can have on health.

Whole grains were the target topic of three speeches within Session 5 that addressed different and complementary facets of this novel food category. Agnieszka Wójtowicz (University of Life Sciences, Poland) reported on the main outcomes of a study on the nutritional and physico-chemical properties of pre-cooked pasta formulated with both refined and whole grain flour from wheat and spelt. She stressed how pasta formulated with wheat and spelt whole flour resulted in a higher protein, ash and fibre content and was also richer in essential amino acids, thus confirming its potential contribution in the reduction of fat absorption and cholesterol. Jan Willem van der Kamp recalled the recommended dietary fibre intake (25-40 g/day for adults) in dietary guidelines, the shift from white to whole grain bread as potentially suitable in lowering the risk of heart diseases, type-2 diabetes and colon cancer, as well as the fact that whole grain products can be an eco-efficient source of nutrients. The core of his speech was about the successful launch, within the EU project, HealthBread, of clean label whole grain bread products with health benefits in Austria, Germany and Italy. These products, made of wheat flour and a special, mild tasting wheat fraction high in fibre and micro-nutrients, and also processed through a long fermentation process, have fibre levels similar to whole grain and an increased bioavailability of beneficial compounds, i.e. iron, magnesium, zinc, folate and anti-oxidants. He highlighted the successful sales of these products as premium ones due to their excellent taste and convincing nutritional and health information. Yanni Papanikolaou (Nutritional Strategies, Canada) reported the most commonly consumed grain food patterns in USA adults and presented figures for nutrient intakes, diet quality and physiological parameters of people that consume foods rich in dietary fibre and whole grain in comparison to individuals that do not consume grain foods. He thus provided evidence that dietary fibre and whole grain intake helps prevent type 2 diabetes and obesity.

Carmela Lamacchia (University of Foggia, Italy) provided an in-depth insight into a new and innovative patented method that allows detoxification of flour for the formulation of pasta and baked goods for coeliac people. The new method, that overcomes the disadvantages of prior methods, is based on the application of microwave energy to hydrated wheat kernels that induces modifications of endosperm components and reduces the immunogenicity of the most common epitopes involved in coeliac diseases without compromising the technological properties necessary to process flour into pasta and bread. Lamacchia stressed that it is likely that structural changes occur in endosperm proteins which are possible while they are still segregated in protein bodies and that such ability is lost in the developed gluten network in dough. The patented method thus opens

the way for coeliac sufferers to overcome a lifelong diet with gluten-free *sensu stricto* products. The last speech of the Session was delivered by Alessandra Fratianni (University of Molise, Italy) who provided an overview of tocopherols recognised for their bioactivity and antioxidant properties and for their ability to modulate several degenerative diseases. She pointed out the main chemical factors that strongly affect their estimation and thus potentially hamper a determination of their real amounts and consequently nutritional potential.

## 6. Safety and authenticity (Session 6)

It is well-known that most of the grains are processed into food products for consumption, so in order to ensure that end food products made from grains are safe and authentic, besides being healthy, it is necessary to enhance the safety of grains from production to processing. Safety of grains has thus to be maintained at every stage, i.e. harvesting, storage, transportation, processing, and storage of processed food. The main risks associated with grain safety are due to chemical residues, field and storage fungi, mycotoxins, rodents and pests, on farm grain storage contamination, contamination during transportation and processing facilities, as well as other processing hazards. In the last decades, control measures are more and more applied to overcome these hazards, e.g. good agricultural practices, proper storage conditions, importance of hazard analysis and critical control points, safety standards for grain storage and processing.

Outstanding speakers were invited to deliver speeches on safety and authenticity issues. The keynote lecture by Pasquale Trematerra (University of Molise, Italy) was on the managements of grains in sub-Saharan Africa by means of decision support tools and integrated pest management; Marco Romani (Ente Nazionale Risi, Italy) was invited to talk about arsenic in rice; Paola Giorni (Catholic University of the Sacred Heart, Italy) was scheduled with a speech on fumonisin contamination in maize kernels and the effect of drying treatments on it; Silvia Generotti (University of Parma, Italy) presented work on strategic mycotoxin mitigation within industrial biscuit making process. And finally, Yannick Weesepeol (Wageningen University and Research Centre, the Netherlands) was invited to present a talk on authentication of organic and conventional produced wheat by liquid chromatography with photodiode array detection analysis of phytochemicals and proton transfer reaction mass spectrometry analysis of volatiles. However, technical problems at the University of Milan hampered a smooth development of the session. Francesca Nocente (CRA-QCE, Italy) delivered a speech on the relationship between homologue composition of 5-n-alkylresorcinols extracted from durum wheat and their antifungal properties, and highlighted that the observed relationship can be considered a contribution towards

the development of eco-friendly antifungal formulations, although future experiments to evaluate the stability and activity of these molecules, as well as their effects on soil microbial communities are required. The speech by Massimo Blandino (University of Torino, Italy) was focused on pre- and post-harvest strategies to minimise the occurrence of 'novel' or 'emerging' mycotoxins in wheat and maize chains.

## 7. Cereal processing and analytical characterisation (Sessions 7 and 8)

Grain processing is one of the oldest and most important food technology and plays a large and important part in the food production chain. Today, the grain processing industry is as diverse as its range of products. Cereal grains can be processed into various different food products, e.g. bread, pasta, breakfast cereals, special cereal products such as gluten-free or whole grain/enriched end-products, etc., and they present enormous processing challenges to food manufacturers.

The last conference day was dedicated to processing and its multiple facets with two sessions that provided an in-depth insight into novel aspects of processing and future challenges. Session 7, chaired by Joel Abecassis (INRA, France) and Rita Acquistucci (CRA-NUT, Italy), started off with the keynote lecture of Stefano Renzetti (TNO Food and Nutrition, the Netherlands) who talked about the challenges in multiple reformulation of bakery products with healthy composition since bakery products with reduced sugar and/or fat content are generally perceived of inferior sensory quality. The Italian scientist highlighted in particular the efforts made and to be made by research and consequently by industry to improve the nutritional profile by multiple reformulation, to maintain the textural and sensory quality thereof, as well as to get consumer acceptance, in terms of appearance, taste, texture, price and nutrition claims. Based on research undertaken within his group, he concluded that high quality reformulated cakes can be achieved by controlling structure formation and that physical parameters controlling the structuring process can be identified by using suitable experimental methods; moreover, according to his experience, a proper experimental design approach can provide valuable information on the effect of ingredients and ingredients combinations on the identified physical parameters.

Carlo Rizzello (University of Bari, Italy) delivered a speech on nutritional, functional and technological advantages of wheat milling by-products and sourdough fermentation, and pointed out the value of germ and bran, discarded during milling despite the high content in dietary fibre and other functional compounds, in comparison with refined cereal flours containing almost exclusively the seed endosperm. Application of sourdough fermentation

with selected starters to a mixture of bran and wheat germ does increase the concentration of functional compounds and improves their technological properties; it also significantly decreases the glycaemic index of bread. He thus stressed the importance of selected lactic acid bacteria and sourdough biotechnology as a useful tool to maximise the technological, nutritional, functional and sensory potential of wheat milling by-products designed as ingredients for new and healthy leavened baked foods. Sourdough was the topic of the speech by Danielle Laure Taneyo Saa (University of Bologna, Italy) as well. The young scientist presented the first outcomes of an EU project on functional bakery products, BAKE4FUN, and highlighted the effects of sourdough fermentation, the interesting enrichment of bread with microencapsulated iron and its influence on iron bioavailability, as well as the antioxidant properties of an experimental functional bread produced with *T. monococcum*. Alain Le-Bail (Oniris, France) discussed the extent to which processing can be considered a tool to reduce salt, sugar and lipids. In particular, he reported on the outcomes of a research study on the use of encapsulated salt in pizza dough to enhance saltiness of bakery products. Finally, Casiana Blanca Villarino (University of the Philippines, Philippines) discussed the effects and processing parameters of the formulation of bread with wheat and lupin flour. Evidence shows, in fact, that lupin bread consumption lowers risk factors, due most likely to its high protein and dietary fibre content, for obesity, cardiovascular diseases, type 2 diabetes and gastrointestinal problems. She nevertheless pointed out the limited commercial success of lupin bread due to lack of understanding how bread making parameters affect bread quality and lack of studies on the use of more robust designs to maximise lupin flour addition and sensory quality (10% at the most).

Alice Moroni (Nestlé, Switzerland) was the keynote lecturer of Session 8, chaired by Martha Cuniberti (INTA, Argentina) and Marina Carcea (CRA-NUT, Italy). The scientist highlighted once more the great demand for whole grain products due to their nutritional and health benefits. She presented a comprehensive overview of the technology, stability and functionality of whole grain flour, but pointed out that the milling procedure is the most crucial process in whole grain flour production and that rancidity and off-flavours are key-issues in this field. The propensity for rancidity is in fact mainly due to the whole grains composition, rich in total fat, mono and polyunsaturated fatty acids, as well as to their higher enzymatic activities and mineral catalysts than their refined counterparts. As a way forward to establish criteria for the selection of a grain variety, and have milling and processing ensuring optimal whole grain product quality, she pointed out the need to: (1) establish cause/effect relationships between whole grain variety, milling technology and flour performance; (2) elucidate the role of lipase, lipoxygenase, polyunsaturated

fatty acids and polar lipids on rancidity and functionality; and (3) provide simple, effective methods for predicting whole grain flour storage tolerance.

Felicidad Ronda (University of Valladolid, Spain) presented the main results of an experiment on the substitution of wheat flour with three different Ethiopian varieties of tef and highlighted that this species is suitable for the formulation of nutritionally rich bread, and stressed the physico-chemical and sensory quality of end-products thereof. Carlos Carvalho (Federal Rural University of Rio de Janeiro, Brazil) presented the main outcomes of a research study about the formulation of food products with sorghum flour and coffee powder rich in antioxidant properties. He provided in particular an overview of the main and most important physicochemical properties of the novel extruded product. The speech by Alessandra Marti (University of Milan, Italy) focused on molecular features of wheat dough enriched with perennial wheatgrass (*Thinopyrum intermedium*) and showed how  $\beta$ -sheets are the predominant structure in enriched doughs as much as in the control dough. She also stressed that enrichment enhances the non-sheet/sheet ratio by increasing the unordered structure at the expenses of the  $\beta$ -sheet structures, without affecting  $\beta$ -turn structures in dough. She concluded that a 50% enrichment with *T. intermedium* represents nevertheless a good compromise between nutritional improvement and maintenance of the starch and protein characteristics in dough. Ismail Dogan (Yüzüncü Yil University, Turkey) delivered a speech on the optimisation of gluten-free wafers with buckwheat flour and potato starch by pointing out their critical processing aspects, e.g. ensuring optimum wafer batter consistency in terms of wafer processing and final wafer properties; varying type and amount of gum in blends depending on used wheat flour substituents; optimising the main components separately. The session was closed by Johan Plijter, representing the conference premium sponsor – Brabender GmbH – who reported on the main outcomes of a long experimentation period with the GlutoPeak®. Roland Poms (Imprint Analytics, Austria) delivered an up-to-date speech on production of reference materials for food allergens and gluten-free analysis for improved food safety and pointed out the main activities that are being undertaken within the MoniQA Working Group on ‘Food Allergen Reference Materials.’

## 8. Posters

The eight scientific sessions were complemented by a poster session hosted in the impressive exhibition area of the Loggiato del Rettorato, where 138 poster presentations encompassed the broad scope of the conference covering all topics presented in the scientific sessions. Although effective science communication in posters is a big challenge, there were nevertheless excellent examples that managed also to be successfully eye-catching and thought provoking in an 80 x 100 cm frame. A jury chaired by Jan Willem van der Kamp and composed of Roland Poms and Chiara Chiriotti first evaluated the submitted abstracts and then the actual posters during the conference and finally selected two posters that were awarded a prize in a dedicated award ceremony, chaired by the ICC secretary general, Michaela Pichler, and Chiara Chiriotti of Chiriotti Editori. The prizes, kindly offered by Chiriotti Editori, were awarded to the two posters that achieved the highest scientific and technical standard, and also displayed innovation and originality: one poster was the effect of debranning on T-2 and HT-2 toxin content in durum wheat kernels and milling fractions (presenting author Gabriella Aureli, CRA-QCE, Italy), and the other one was the protective effect in coeliac disease played by a gastrointestinal resistant peptide from *T. monococcum* omega-gliadin (presenting author Gianfranco Mamone, CNR-ISA, Italy).

## 9. Concluding remarks

The conference participants who took part in the social dinner also had the opportunity to visit the Bolognini Castle in Sant’Angelo Lodigiano, an impressive building dating back to the fifteenth century.

Information and book of abstracts are also available on the conference website: <https://expo2015.icc.or.at/home>.

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