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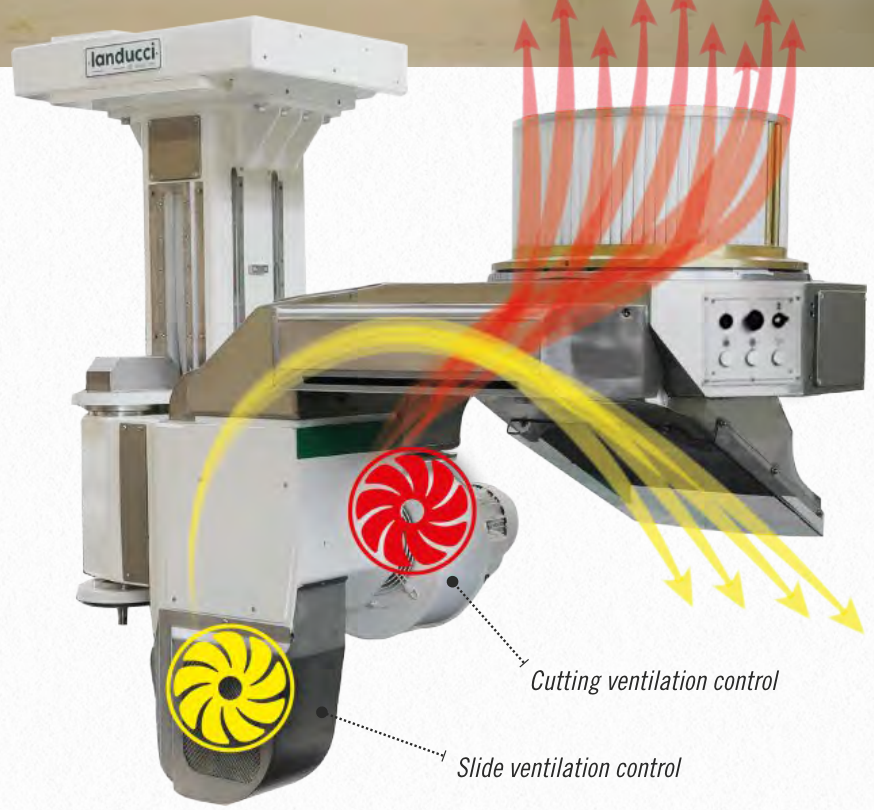

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November

PUBLISHER
Kinski Editori S.r.l.
registered office
Via Possioncella 1/1 • 42016 Guastalla
operational headquarters
Via Dall'Aglio 21/2 • 43122 Parma (Italy)
tel. +39 (0)521 1564934
fax +39 (0)521 1564935
Email redazione@pastaria.it
ROC no. 23238

EDITOR-IN-CHIEF
Lorenzo Pini

INTERNET SERVICE PROVIDER (ISP)
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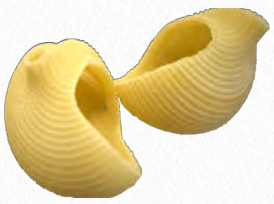

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Pastaria Festival 2020 rises to the challenge of moving online

Editorial staff

More than 300 operators (including over 100 pasta factories) registered for the first ever virtual Pastaria Festival. More than 10 hours of live streaming, with simultaneous interpreting into English, 15 sessions and three international association meetings: Pastaria Festival 2020 has risen to the challenge of moving online, while looking forward to the opportunity to come together in person again in the future.

Alt was certainly an unusual opening session for Pastaria Festival 2020, held entirely online for the first time on 25 September last.
Lorenzo Pini, publisher and editor-in-chief of Pastaria, opened the traditional annual event of professional information and updating for pasta manufacturers from his home office, rather than a conference centre. This highly unusual situation “attests to our common need and, we hope, to our ability to adapt, but also our determination to be present, to move forward and to be resilient, to use a term we are hearing a lot at the moment”.
“I think I can say – Pini continued in his welcome speech – and not without a tentative hint of pride, that as truly regrettable as it is not to be able to meet in person, this is the first large, substantial, business-to-business conference and networking event for the pasta industry to be held entirely online.
We have tried to transfer as much as possible from the traditional event to the virtual format. As such, we have endeavoured not to sacrifice the detailed structure, variety and scope of the programme, including parallel sessions (albeit a small number), or the growing international interest (attested to by the six conferences translated simultaneously into English). Nor did we stray from our commitment to ensuring that all initiatives involved in Pastaria Festival are free of charge, in keeping with the particular publishing model in which our publishing house specialises that, in the spirit of open access, makes information freely available free of charge, a defining feature rivalled only, perhaps, by our decisive and extensive use of the tools provided by new technologies.
It has involved a significant effort, which has truly put us to the test. We have navigated uncharted waters, but it has not been a lone voyage. Pastaria Festival is a collective event, fruit of the invaluable effort of many people and the collaboration of numerous businesses.”
Pastaria Festival 2020 also featured opening speeches by the following people, representing their respective associations: Paolo Barilla (International Pasta Organisation), Carl Zuanelli (National Pasta Association), Fabio Fontaneto (Associazione produttori pasta fresca della piccola e media impresa e dell’artigianato), Claudio Zanão (Associação Brasileira das Indústrias de Biscoitos, Massas Alimentícias e Pães & Bolos Industrializados), Manuel Airoldes (Unión Industrial de Fideeros de la República Argentina), Riccardo Felicetti (Unione Italiana Food). Their speeches are available here:
https://pastaria.it/pastaria-festival-2020-i-discorsi-di-apertura/.

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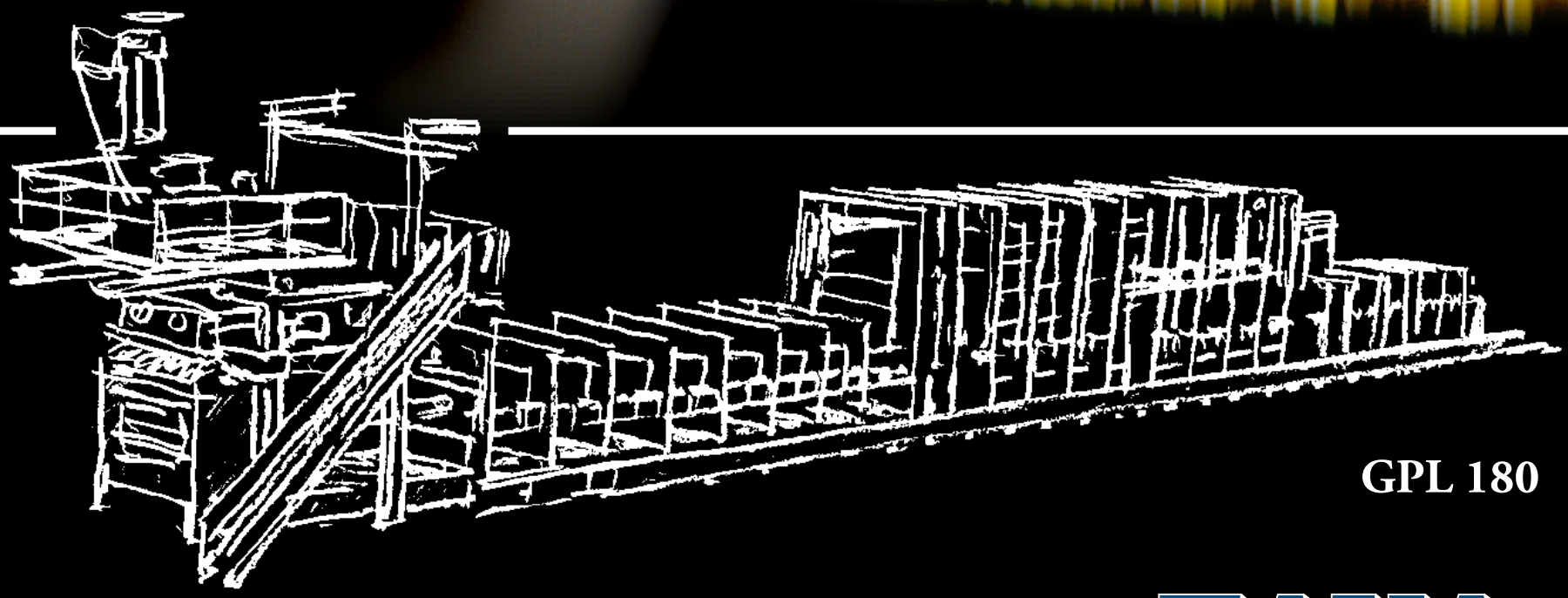

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The Programme

Six international conferences, translated simultaneously into English, summarised the state of academic research into pasta and global consumption trends.

Below are the titles of the international conferences held as part of Pastaria Festival:

- *Pasta, ingredients, health and nutrition*
- *Opportunities and challenges for pasta packaging*
- *Pasta: between science and fake news*
- *Fresh pasta and quality: from the dough to the label*
- *Quality and process in dry pasta production: from the grain to the information on the label*
- *Pasta consumption and the pandemic: global scenarios and trends, from retail to food service*.

In keeping with the spirit of the event – which makes sharing knowledge and skills regarding pasta making its mission – significant and popular presentations were delivered by various companies that supply technologies and ingredients to pasta factories, and specifically:

- *Wellmune and GanedenBC30, supporting your immune system (Kerry Group)*
- *Molini Pivetti – Durum wheat and more for fresh pasta (Molini Pivetti)*
- *Flavourland and the use of flavourings in fresh and filled pasta (Flavourland)*
- *Sensory nuances in sauces (Kerry Group)*
- *Automatic lines for filled pasta and precooked gnocchi (Pasta Technologies Group)*
- *Flavourings and Clean(er) Label (New Flavours)*.

As always, Italian and international associations were central to the event.

IPO (International Pasta Organisation), UNAFPA (Union des Associations de Fabricants de Pâtes Alimentaires de l'U.E.), and – for the first time – Semouliers (representing European millers), held their meetings during Pastaria Festival.

The NPA (National Pasta Association), the association of American pasta manufacturers, represented by its chairman Carl Zuanelli, delivered the interesting and very popular presentation entitled *State of the US pasta industry. Pasta: a Renaissance*.

The registered pasta factories

More than 100 pasta factories registered for Pastaria Festival 2020: Agnesi, Alloro, Amore per la Pasta Srl, Barilla G&R F.lli Spa, Bertagni 1882, Cafes La Virginia Sa, Canuti Tradizione Italiana Srl, Cerealto Siro, Colussi Spa, Cooperativa Il Grigio, De Cecco, Delfino Fratelli Snc, Di Amante Pastartigianale Srl, Dialcos, Directus International Ltd, Domenico Paone Spa, Emporio

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The papers

The papers from Pastaria Festival will be published in instalments in Pastaria, starting from the next issue.

The next edition

The next Pastaria Festival will be held in September 2021.

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Innovative biopolymer-based packaging: prospects for the pasta sector

Elena Torrieri
Department of Agricultural Sciences, University of Naples Federico II, Italian Scientific Group of Food Packaging (GSICA)

Biopolymers – better known as bioplastics – can play an important role in the transition from a linear to a circular economy. This is true in the pasta sector too.

Introduction

Approximately 1.3 billion tonnes of food is wasted globally each year. Packaging in general, and plastic packaging in particular, plays a key role in reducing such waste, preserving the quality of the foods and ensuring that they remain safe to use throughout the distribution and sales phases. The benefits of using plastic materials in the food sector, however, must not overshadow the problems associated with the environmental impact of their production and disposal. Based on available data for 2018, a *Plastics Europe* report stated that global plastics production had reached 360 million tonnes, while in Europe alone, it is estimated that 40% of the plastic produced (approximately 62 million tonnes) is used to produce packaging (Plastics Europe & Conversio Market & Strategy GmbH, 2019).

The waste represented by both food and non-food packaging has for years been the subject of specific European legislation and constant monitoring by Member States. In January 2018, the European Commission proposed a European strategy for plastic materials, aimed at moving toward a circular economy (COM 2018- 28). The objective is to achieve a 55% reduction in packaging waste by 2030, promoting recycling and the development and use of innovative materials and alternative raw materials to produce plastic.

In this context, biopolymers – better known as bioplastics – can play an important role in the transition from a linear to a circular economy.

Biopolymers: origin and classification

Biopolymers belong to the category of bio-based materials, i.e. organic materials in which the carbon comes exclusively from renewable biological resources. More specifically, a biopolymer is a polymer-based material directly or indirectly extracted from biomass (Piergiovanni & Limbo, 2010).

Depending on their origin, biopolymers can be divided into three categories:

1. polymers obtained from natural plant or animal sources, such as polysaccharides and protein

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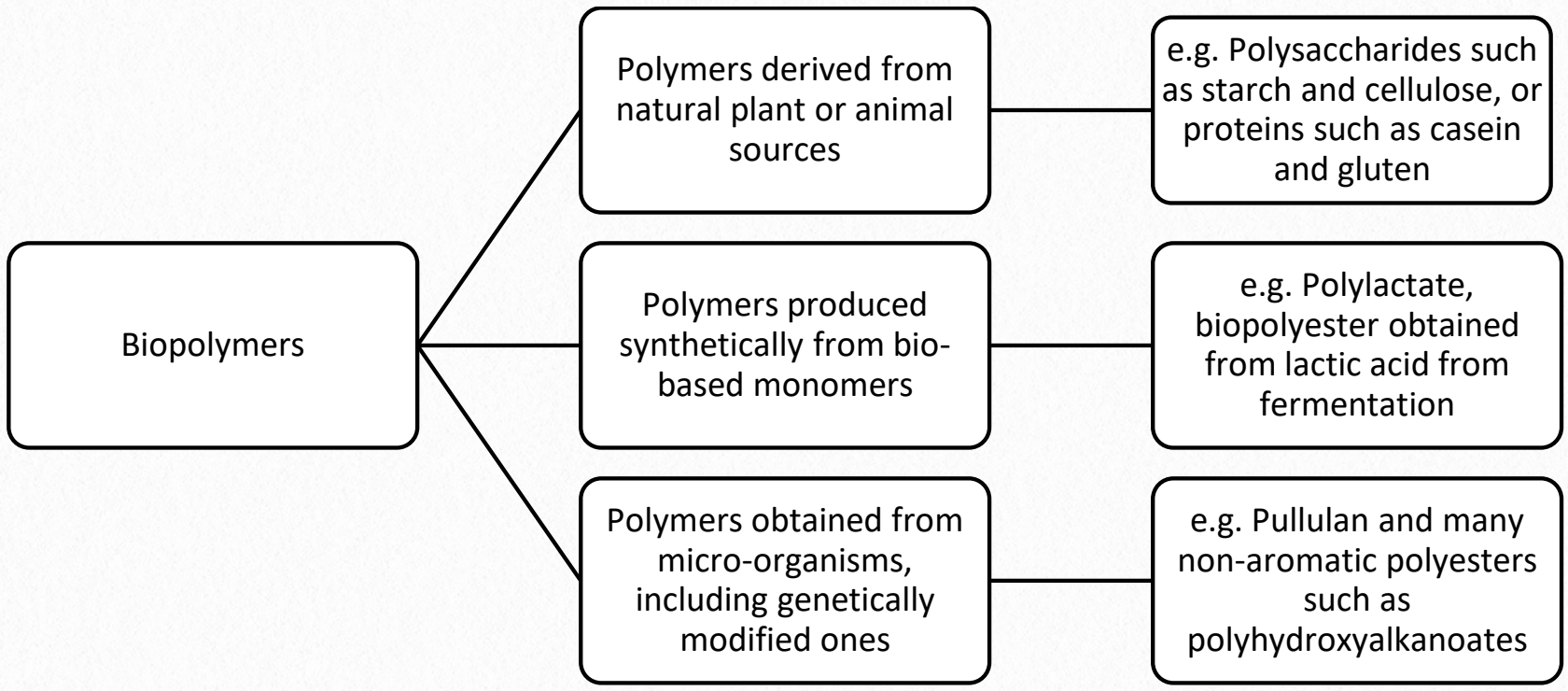
Figure 1 **CLASSIFICATION OF BIOPOLYMERS**



2. polymers obtained synthetically from bio-based monomers, such as polylactic acid (PLA)
3. polymers derived from microbial metabolic reactions, such as polyhydroxyalkanoates (PHAs), polyhydroxybutyrates (PHBs) polyhydroxyvalerate (PHV) and xanthan and bacterial cellulose (Figure 1).

According to European Bioplastics, Nova-Institute the bioplastics market is characterised by a significant growth rate and strong diversification (Figure 2). Market data show the application of biopolymers across various sectors, with the sector involved in producing flexible and rigid food packaging at the top of the list.

Biopolymers extracted directly from natural sources

The polymers obtained from natural sources are polysaccharides, proteins and lipids, or a combination of these molecules capable of interacting with each other to create stable and functional matrices. Cellulose is an excellent example of this: the most abundant natural polymer on earth, it is essentially an unbranched polymer of glucose with a long, linear chain. Thanks to its regular structure and the hydrogen bonds that form between the hydroxyl groups on the adjacent chains, the cellulose chains aggregate to form fibrils that, in turn, wrap around each other to form fibres. These biopolymers are extracted

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from plant and animal sources by way of physical processes, and can be used in industrial applications in the form in which they are extracted or following chemical modification. The former are referred to as polymers that have not been chemically modified, while the latter are their compounds. Cellulose acetate is a typical example of modification of a natural biopolymer. It is interesting to note that natural biopolymers are biodegradable, while chemical modification may result in non-biodegradability (e.g. cellulose acetate) depending on the degree of substitution.
These biopolymers are used to produce materials with good mechanical properties that provide a barrier against gases such as oxygen and carbon dioxide. Unfortunately, due to the chemical and physical characteristics of the molecules – in terms of surface charge, conformation and molecular weight – the films derived from biopolymers have poor water vapour barrier properties, which often limits their use in the food packaging field (Han & Gennadios, 2005). Among the various solutions considered to improve the properties of biopolymer-based films, one possibility involves using combinations of biopolymers that may interact to produce matrices with interesting structural properties. This effect is due to the fact that the functional properties of proteins – such as solubility, surface tension, gelation, conformation stability, emulsification and foaming properties – are positively affected by interactions with polysaccharides. The resulting matrix also interfaces better with other elements such as lipids, water, surfactants and ions, and is mechanically stronger and more stable overall (Giancone, Torrieri, Masi, & Michon, 2009).
The Department of Agricultural Sciences at the University of Naples Federico II has conducted research into systems using polysaccharides and proteins, with the aim of developing biopolymer-based films or coatings that could be used to extend the shelf life of highly perishable foods (Bruno, Giancone, Torrieri, Masi, & Moresi, 2008; Perone et al., 2014). A study published in 2017 reported results relating to a complex system based on chitosan and caseinate (Volpe, Cavella, Masi, & Torrieri, 2017). Chitosan is the second most commonly occurring polysaccharide in nature, after cellulose. In chemical terms, it is a linear polysaccharide, made up of D-glucosamine and N-acetyl-D-glucosamine, linked by β(1-4)bonds. It is a natural macromolecule, regarded as the most soluble derivative of chitin, a polysaccharide extracted from the exoskeleton of invertebrates, and crustaceans (crabs and shrimp) in particular. Chitin is structurally similar to cellulose, but it is an amino-polysaccharide with aceta-

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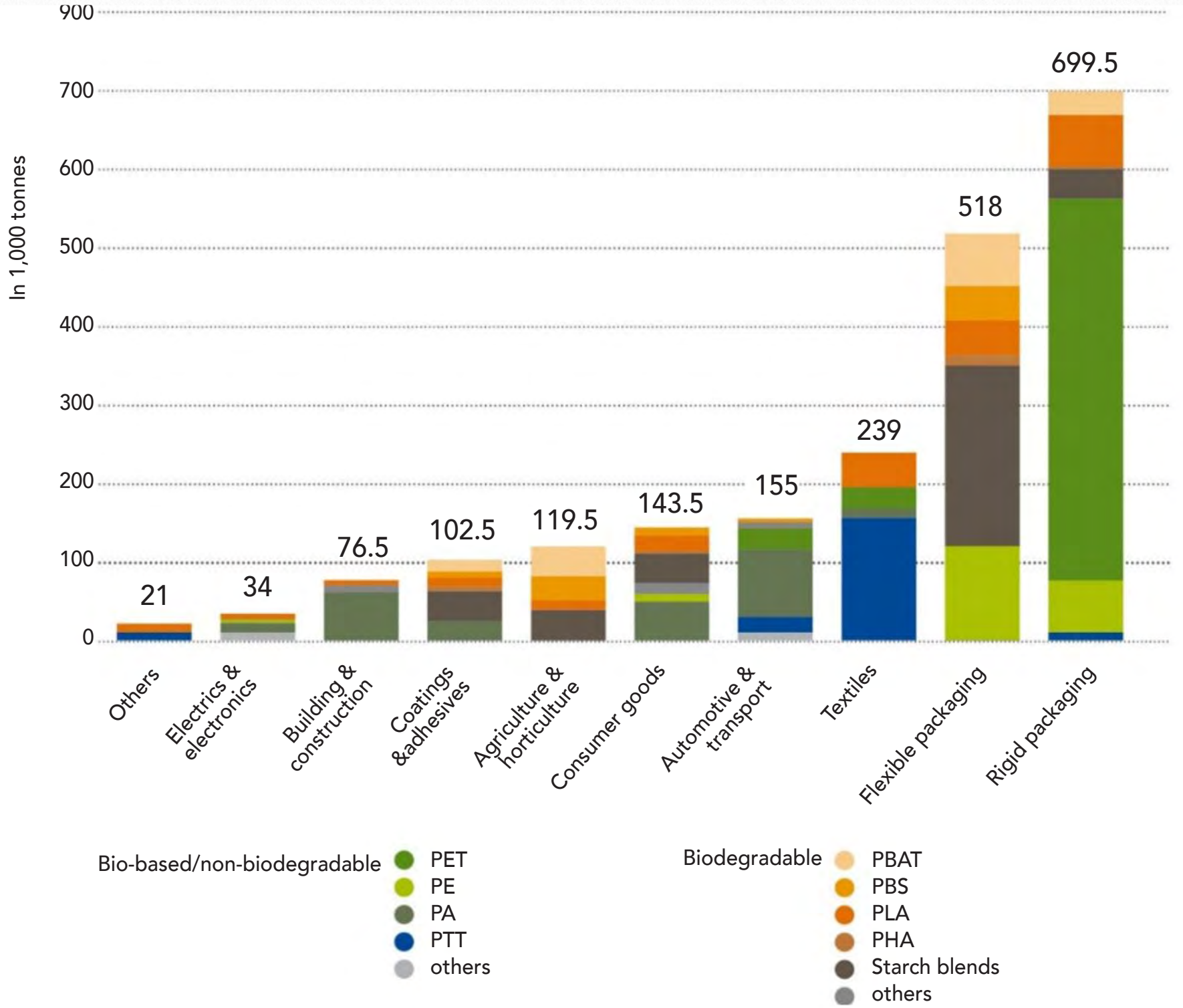
Figure 2 GLOBAL BIOPLASTIC PRODUCTION CAPACITY IN 2018



Source: European Bioplastics, nova-Institute (2018)

mide groups in the C-2 positions, in place of the hydroxyl groups. In its solid state, chitosan has a double helix conformation, stabilised by intramolecular hydrogen bonds. It is used to produce films with good gas barrier properties, or as a coating to functionalise materials that are sensitive to such gases. As with biopolymers in general, chitosan-based films have poor water vapour barrier properties, due to the high hydrophilicity of the molecule. Furthermore, the addition of certain additives such as glycerol – a plasticiser widely used to produce biodegradable films – tends to increase the hydrophilicity of the film when applied in the right concentrations (Vargas et al. 2009).

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Caseins are among the most interesting proteins as regards developing biopolymer-based films. Casein micelle is a protein-based hetero-aggregate, made up of various sub-micelles. It contains four main types of protein: αs1, αs2, β-caseina, e k-casein. Casein micelles occur in milk plasma as a well-structured sphere, consisting of a hydrophobic core featuring α and β casein, and a hydrophilic shell featuring k-casein. The various micelles that make up the casein molecule are stabilised by numerous hydrogen bonds, hydrophobic interactions and electrostatic interactions, which make the molecule extremely resistant to heating, but also extremely sensitive to pH variations and ionic concentration variation. In the context of a solution, casein exhibits amphiphilic behaviour, responsible for its excellent emulsifying properties. It is used in saline form, or in the form of sodium caseinate. The latter is widely used due to its good mechanical characteristics and, above all, its oxygen and carbon dioxide barrier properties. Like chitosan, however, it is highly permeable and sensitive to water vapour (Sheng et al. 2008).

During mixing, two types of phenomena may occur:

1. associative interaction, in which the two polymers attract one another, and therefore bind together
2. segregative interaction, in which the two polymers repel one another due to their chemical nature (Tolstoguzov, 1997).

In the case of highly diluted solutions, the system can be considered stable; given the conditions of minimal entropy, the proteins and polysaccharides solubilize. As the concentrations increase, the system starts to become unstable, and the segregation or association phenomena referred to above may occur due to the chemical and conformational nature of the biopolymers in question. In the case of interactions between proteins and polysaccharides, the latter become adsorbed on the surface of the former, and if the molecular size of the polysaccharides is not sufficient, they may be adsorbed onto other protein molecules such as casein micelles, creating associative attractions among the various micelles and excluding the solvent in which the two polymers are dissolved. This phenomenon is called complex coacervation (De Kruif & Tuinier, 2001).

In chemical terms, one of the chemical models that explains the mechanism involved in the formation of the sodium caseinate and chitosan matrix is as follows: in an acidic environment, the amino groups (NH_2) of chitosan are protonated into ammonia ions (NH_3^+), resulting in electrostatic interactions with the anion groups of sodium caseinate, which, at a dissolu-

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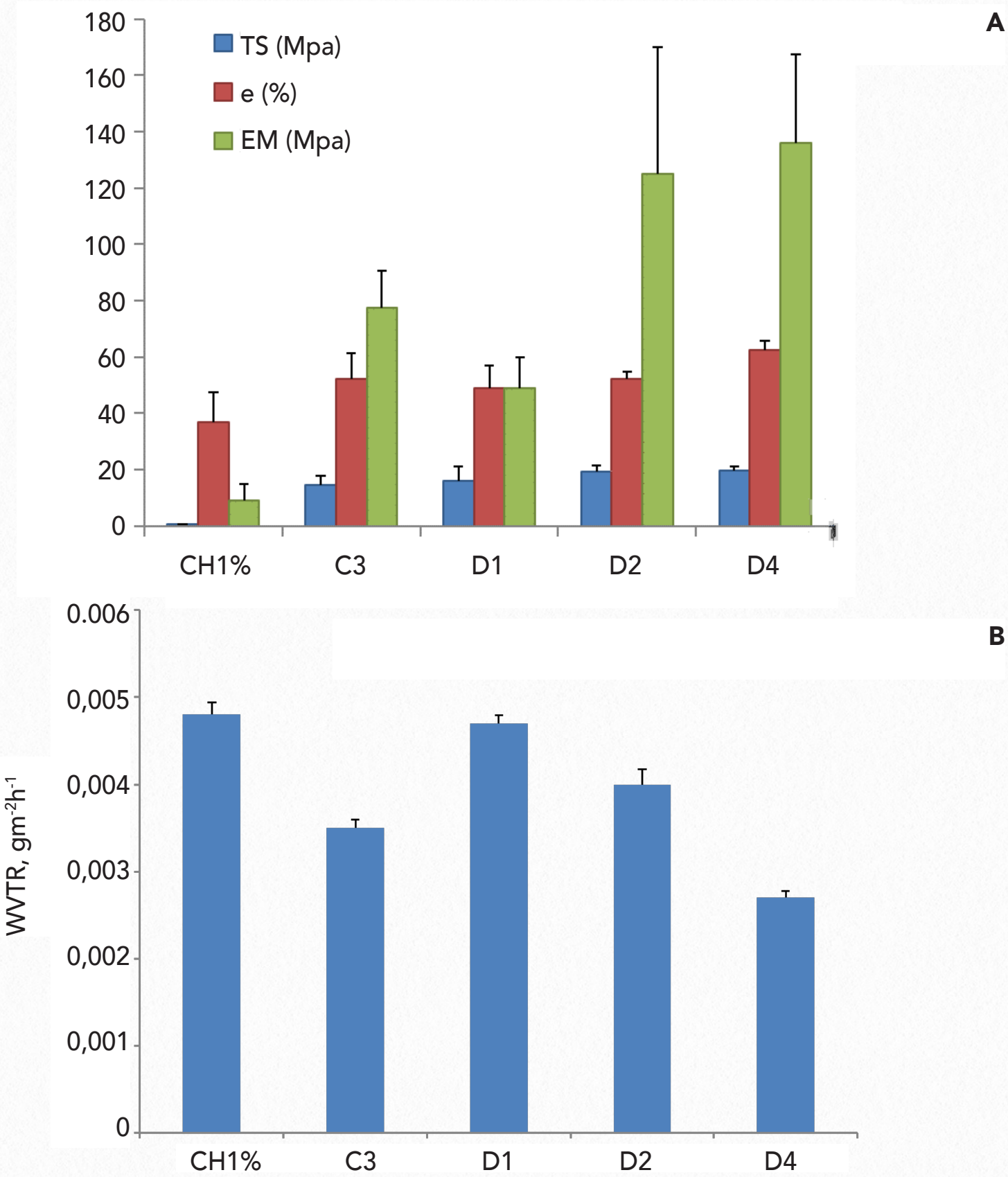
Figure 3 MECHANICAL PROPERTIES (A) AND WATER VAPOUR BARRIER PROPERTIES (WVTR) (B) OF CHITOSAN-BASED FILMS (CH1%) AND CASEINATE AND CHITOSAN BLENDS AT VARIOUS CONCENTRATION RATIOS. C3: SC/CH=2; D1: SC/CH=0.5; D2: SC/CH=1; D4: SC/CH=2



tion pH of between 7 and 8, exhibits a negative surface charge due to the HPO_3^- groups (Pereda et al., 2008). This leads to the formation of a stable associative bond between the two molecules, resulting in a matrix with interesting functional properties.

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Starting with the work by (Volpe et al. 2017), studies have looked at how various concentrations of chitosan and caseinate influence the structure and properties of the resulting films. The physical, mechanical and microstructural properties of the various formulations have been studied, with results indicating that the sample obtained using 4% (p/v) casein and 2% (p/v) chitosan produced a biopolymer with improved mechanical properties, as the increased caseinate/chitosan ratio resulted in an enhanced elastic modulus (Figure 3A). Furthermore, it was demonstrated that in the context of such concentrations of polysaccharides and proteins, the polyelectrolyte complexes were capable of performing charge neutralisation, thus reducing the hydrophilic nature of the film and obtaining lower water vapour permeability (WVP) values with the increase in solids (Figure 3B). For these reasons, this material could be used for various food applications, including as an edible coating for foods (Volpe, Torrieri, & Cavella, 2018).

Recent applications in the pasta sector

Biopolymer-based packaging is not widely used in the pasta sector, and little research has been published in relation to this application. One of the first works was recently published on the use of biodegradable packaging made from triticale flour for dried pasta. The films were used to produce heat-sealed bags. The thickness of the film was approximately 170 µm, while the water vapour permeance was $2x10^{-11}$ g s^{-1} m^{-2} Pa^{-1}. No variations were observed in the properties of the films, aside from a colour variation after 30 days, and minor variations in the mechanical properties after 45 days of storage. The bags made from biopolymer films were used as packaging for dried pasta samples (relative humidity of 9%). The pasta samples were stored for 45 days at room temperature. Pasta packaged in commercial packaging was used as a reference sample. The pasta stored in the two types of packaging did not present significant differences during storage in terms of colour, mechanical properties and optimal cooking time. A reduction in antioxidant properties was observed only in the samples packaged using biodegradable packaging. All samples complied with the microbiological limits set by law. To conclude, the results showed that pasta can be stored for 45 days in biodegradable bags made using triticale flour. The only critical issue identified was a lower oxygen barrier that could lead to a reduction in the antioxidant properties of the nutritional components (Aranibar et al., 2020).

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A study published in 2013 presented promising results as regards the use of biopolymer-based active (antimicrobial) films for fresh pasta packaging. The films were made from blends of starch, poly (butylene-adipate-co-terephthalate), glycerol and potassium sorbate (De Camargo Andrade-Molina, Shirai, Victória Eiras Grossmann, & Yamashita, 2013). The films were used in contact with the fresh pasta, which was then placed in packaging made from a polymer material with water vapour barrier properties. The results demonstrated that, in the presence of 3% potassium sorbate, the films may offer an alternative to the use of preservatives or modified atmosphere packaging, guaranteeing a 35-day shelf life for fresh pasta stored at 7°C (Sousa, Yamashita, & Soares Júnior, 2016).

A recent study considered the use of active films based on chitosan and chestnut extracts as an alternative to the commercial materials used to package fresh pasta. While the films guaranteed the microbiological safety of the samples for the 60-day storage period (at 8°C), they proved ineffective in preserving the moisture of the product, with the loss of the textural properties characteristic of fresh pasta after just 9 days (Kõrge, Bajić, Likozar, & Novak, 2020). The water vapour barrier properties of those materials are therefore not yet suitable for preserving fresh pasta in terms of protecting it against changes associated with loss of moisture of the product.

Conclusions

Films made from biopolymers from natural sources have the potential to serve as excellent substrates for the production of films with a low environmental impact. The properties of such materials, however, are not comparable to those of films of synthetic origin, particularly in terms of their water vapour barrier properties. Their use as substrates to develop active films to be used in contact with food may offer an interest solution to minimise the use of costly and complex technologies, such as modified atmosphere packaging, or as a material to be combined to traditional packaging, to promote the use of polymers that are as recyclable as possible.

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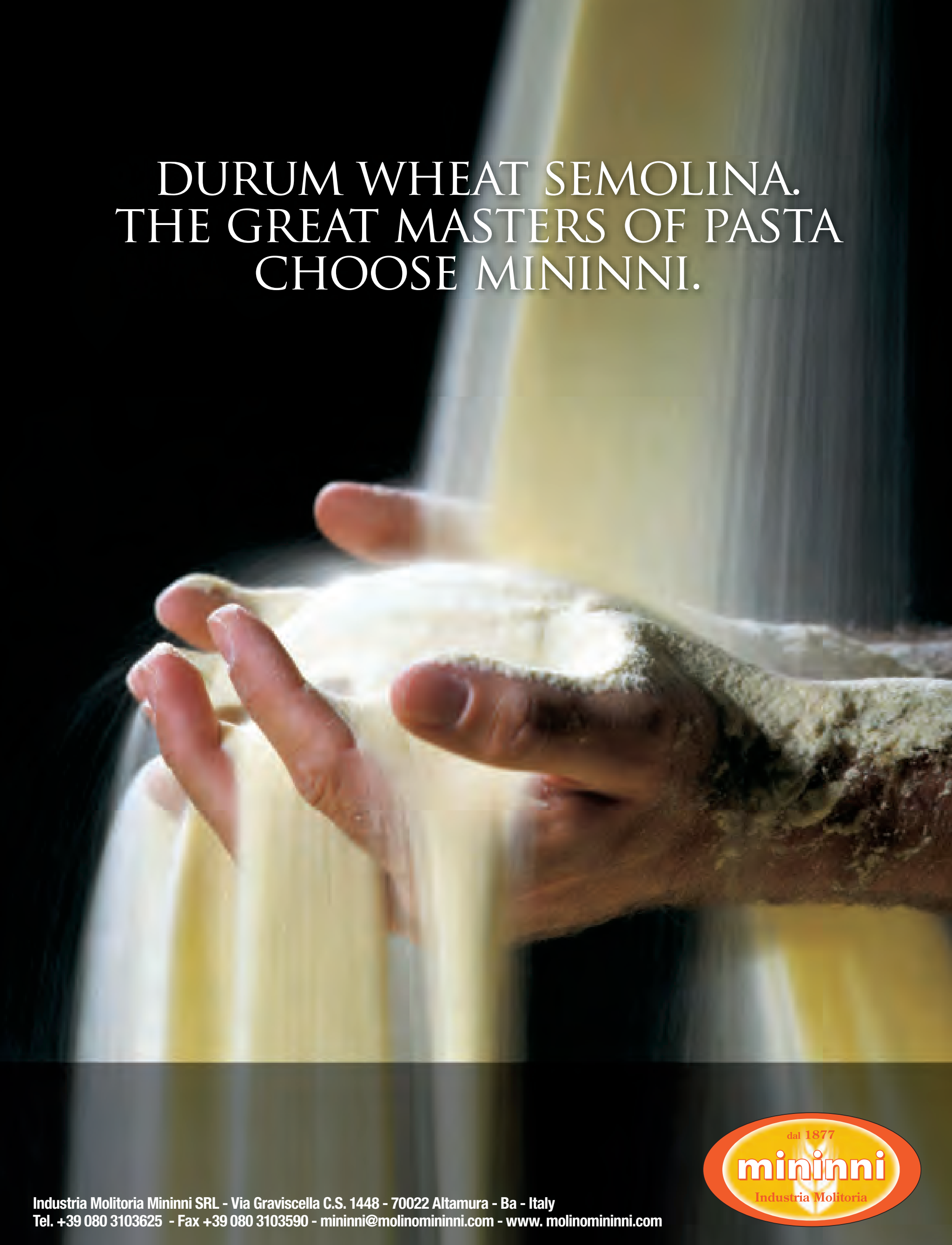

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3

Pasta from pulses: role of the raw material and effect of the pasta-making process

Francesca Casaretta

The suitability of red and yellow lentil flours for making pasta, before and after pre-gelatinization, has been explored for a degree thesis, a summary of which is presented here. The project won one of the Pastaria 2020 Awards.

Introduction

Thanks to their high nutritional value, low environmental impact and low production costs, pulses are interesting raw materials to use in the production and reformulation of foodstuffs. In fact, pulses respond to consumers' growing demand for products with a high protein and fibre content, that are also gluten-free (Hunter & Der, 2017). In addition to being an excellent source of protein (15-30%) rich in lysine and fibre (15-39%), pulses are also rich in vitamins (folates, thiamine and riboflavin), minerals (potassium, magnesium, iron and manganese) and bioactive compounds, such as phenols and γ-aminobutyric acid (Hall et al., 2017).

Despite this fact, there tends to be a low consumption of pulses in Western countries, due to the presence of antinutrients and long preparation times. To promote their consumption, one approach could be to use them in the reformulation of cereal-based foods (such as bread and pasta) (Sozer et al., 2016). Pasta is, in fact, a dish that enjoys a very high appeal thanks to its long shelf-life, simplicity of preparation, good sensory characteristics and low cost. (Marti & Pagani, 2013).

The growing trend towards the consumption of gluten free (GF) foods with high nutritional value is steering the industry towards the use of pulses. However, the production of gluten free foods, such as bread and pasta, with structural and sensory characteristics similar to those of wheat-based products has given rise to a major technological challenge. (Marti & Pagani, 2013). Gluten free pasta made with cereals, such as rice and corn, is produced by means of two approaches, the common feature of which is the use of starch that is partially gelatinized and hence able to rearrange itself in an organized – and therefore compact – structure during the pasta-making process. (Marti & Pagani, 2013).

The first approach involves the use of heat-treated flour, in which the starch is already mostly gelatinized. In this case, the pre-treated flour can be transformed into pasta by means of the conventional extrusion process, commonly used in the production of durum wheat semolina pasta. In the second technological approach (extrusion-cooking process), the native flour is treated with steam and extruded at high temperatures (over 100 °C) to trigger the gelatinization of the starch directly inside the extruder-cooker (Marti & Pagani, 2013). Although these processes have been extensively studied for cereals (corn and rice), there is no information on their applicability on pulse flours.

Therefore, the purpose of this study was to assess the pasta-making aptitude of native

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or pre-gelatinized red and yellow lentil flours. Secondly, the study focused on the identification of the pasta-making process (conventional vs extrusion-cooking) that would result in a finished product with good cooking behaviour.

Materials and methods

Materials

IIn this study, the following flours supplied by Molino Favero (Padua, Italy) were used: native red lentils; pre-gelatinized red lentils; native yellow lentils; pre-gelatinized yellow lentils. For confidentiality reasons, the details of the heat treatment cannot be shared.

The dried pasta was produced at the pilot systems of the Department of Food, Environmental and Nutritional Sciences (DeFENS) of the University of Milan. Specifically, six types of dried pasta were produced using two different production processes (Table 1). All the flours were mixed with water in order to obtain a final dough with a moisture level of 40%.

With regard to the conventional pasta-making process (process 1) with a continuous press (Braibanti, Milan, Italy), after kneading for 12 minutes, the flour and water mix was extruded at a temperature of 50 °C and a pressure of 10-11 MPa. The product obtained in the form of tortiglioni rigati was then dried in a medium temperature cycle (17 hours; maximum temperature 65 °C).

Pasta-making by means of extrusion-cooking (process 2), on the other hand, involved the pre-cooking with steam of the native flours followed by extrusion with a screw heated to 115°C in a extruder-cooker (Progel®; Braibanti, Milan, Italy). At the end of the extrusion-cooking phase, cylindrical shapes (3-4 mm) called pellets were obtained. The pellets were then transferred to the continuous press and extruded in the shape of tortiglioni rigati, as per process 1. The product was then dried under the same conditions as process 1 (65°C/17h).

Methods

Flour characterization

The amount of starch susceptible to enzymatic hydrolysis (an index also known as damaged starch) was determined in duplicate using the official AACCI method 76-31 (2000). The values were also expressed in relation to the total starch content, evaluated using the AACCI method 76-13.01 (2000).

The capacity to absorb and retain water was assessed by the Water Absorption Index (WAI) and the Water Binding Capacity (WBC), respectively, using the official AACCI method 56-30.01 (2000). The re-

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Table 1 **EXPERIMENTALLY PRODUCED DRIED PASTA SAMPLES**

Flour	Technological process	Pasta Reference
Native red lentils	Conventional with continuous press (Process 1)	LR TQ-CONV
	Pasta Reference	LR CE
Pre-gelatinized red lentils	Conventional with continuous press (Process 1)	LR PRE-CONV
Native yellow lentils	Conventional with continuous press (Process 1)	LG TQ-CONV
	Extrusion-cooking (Process 2)	LG CE
Pre-gelatinized yellow lentils	Conventional with continuous press (Process 1)	LG PRE-CONV

sults obtained (expressed in grams of water per gram of sample) refer to the mean of three tests.

The gelatinization and retrogradation properties of the starch were determined by means of the Micro Visco-Amylo-Graph (Brabender OHG, Duisburg, Germany) on 12 g of sample and 100 ml of distilled water corrected for a moisture content of 14%. The thermal profile applied provides for a temperature gradient of ±1.5°C/min.

Pasta characterization

The cooking behaviour of the pasta was evaluated at the optimal time (OCT= 6.5 min) and on overcooking (OCT +20% = 8 min). The samples were cooked using a pasta:water ratio of 1:10 (25 g sample in 250 ml distilled water).

The water absorption capacity was calculated by comparing the weight of the pasta before and after cooking. The results refer to the mean of three independent cooking tests.

In order to determine losses during cooking, the AACCI 66-50 (2000) method was used. The cooking water residue was expressed as grams of substance lost per 100 g of dried product. The results refer to the mean of two replicates of three cooking tests.

The texture of the cooked pasta was evaluated by a compression-cutting-extrusion test, using a Kramer shear cell. The Zwick Z005 dynamometer (Zwick GmbH & Co., Ulm, Germany) equipped with a 5 kN load cell was used. The results refer to the mean of three independent tests. From the elaboration of the recordings, it was possible to obtain the maximum load index (N), which expresses the maximum texture of the pasta and the total work index (N*mm),





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Table 2 **EFFECT OF PRE-GELATINIZATION TREATMENT ON THE SUSCEPTIBILITY OF STARCH TO α-AMYLASE AND ON HYDRATION PROPERTIES**

Red lentils	Susceptibility to enzymatic hydrolysis (g/100g total starch)	WAI (g/g)	WBC (g/g)
Native flour	4.9 **	1.01	0.84
Pre-gelatinized flour	5.4	1.10	0.86
t-Test	p<0.01	n.s.	n.s.
Yellow lentils	**Susceptibility to enzymatic hydrolysis (g/100g total starch)**	**WAI (g/g)**	**WBC (g/g)**
Native flour	4.6 ***	0.99	0.87
Pre-gelatinized flour	6.3	1.03	0.85
t-Test	p<0.001	n.s.	n.s.

n.s.: no significant difference

determined by the area under the curve from the moment in which the probe comes into contact with the sample until the end of the test.

Statistical data analysis

The statistical analysis was conducted using Statgraphics Plus 5.1 software (Statpoint Inc., Warrenton, VA, USA). The various samples were considered as factors for the one-way analysis of variance (ANOVA) and, when a factor showed statistical significance ($p<0.05$), the differences between the respective means were determined by Tukey's HSD test. Any differences between two samples were, on the other hand, evaluated using the t-Test.

Results and Discussion

Effects of the pre-gelatinization treatment

The susceptibility of starch to enzymatic hydrolysis makes it possible to understand the impact of pre-gelatinization treatment on the characteristics of starch. This pre-treatment leads, as is well known, to a loss of the granule's native organization and its assumption of new properties, first and foremost the capacity to be rapidly hydrolyzed by amylase. The pre-gelatinization treatment only brought about a slight – albeit significant ($p<0.01$) – increase in the starch's susceptibility to enzymatic hydrolysis, which rose from a value of 4.9% (expressed on total starch) to a value of 5.4%

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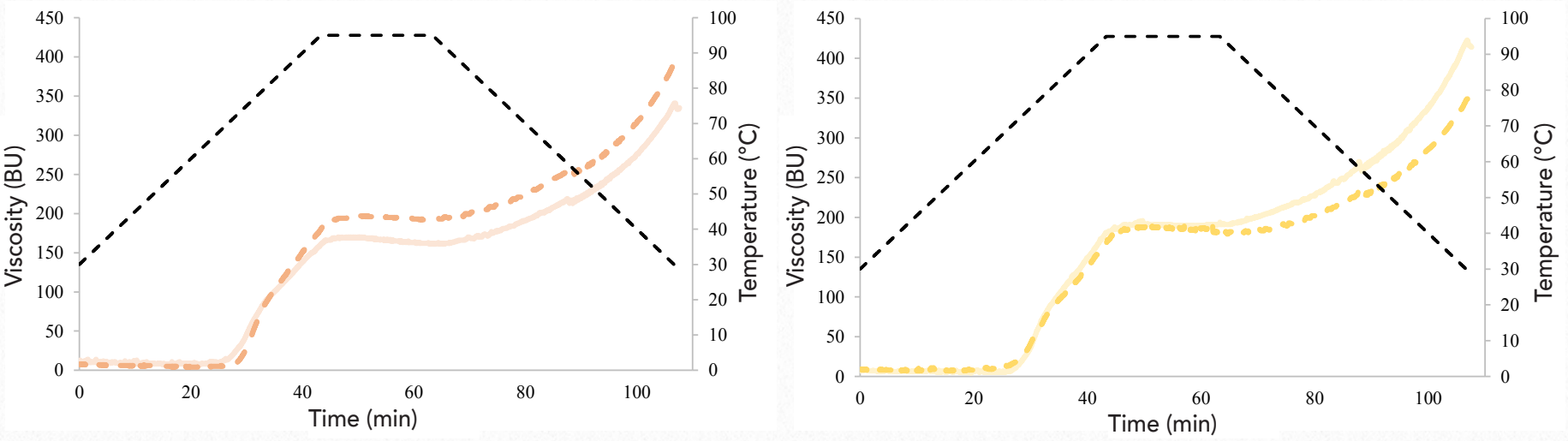
Figure 1 MICRO-VISCOAMYLOGRAPHIC RECORDINGS OF NATIVE RED LENTIL FLOUR (LEFT) AND NATIVE YELLOW LENTIL FLOUR (RIGHT) (CONTINUOUS LINE) AND PRE-GELATINIZED FLOUR (DOTTED LINE)



for red lentils and from 4.6% to 6.3% for yellow lentils (Table 2).

Generally, pre-gelatinized rice or corn flours presented enzymatic susceptibility values of around 50% (Marti et al., 2013). In pulses, low susceptibility to enzymatic hydrolysis is probably due to the different types of starch. In fact, the higher amylose content (24-33% in lentils (Oomah et al., 2011) brings about an increase in the granule's resistance to swelling and gelatinization, leading to a reduction in damaged starch content. (Bettge et al., 2000).

The pre-gelatinization treatment applied by the company does not seem to significantly alter the hydration properties of the flours (Table 2). Although unexpected (particularly when compared to the outcome for rice (Marti et al., 2013), this result is in line with the slight effect of the treatment on the susceptibility of starch granules to enzymatic hydrolysis.

A micro-viscoamylograph analysis (Figure 1) was conducted to investigate the effect of the pre-gelatinization treatment on the gelatinization and retrogradation properties of starch.

The pre-gelatinization treatment brought about some slight changes in the amylaceous structure of the flours (Figure 1). These changes, however, depend on the raw material in question. Specifically, the pre-gelatinization treatment applied to red lentils endows the starch with a greater capacity to absorb water and swell, resulting in higher viscosity values.

Effect of the pasta-making process

At optimal cooking time, LR CE pasta absorbs less water, and this behaviour is maintained even after overcooking (Table 3). Furthermore, the cooking losses for this sample were significantly higher in com-

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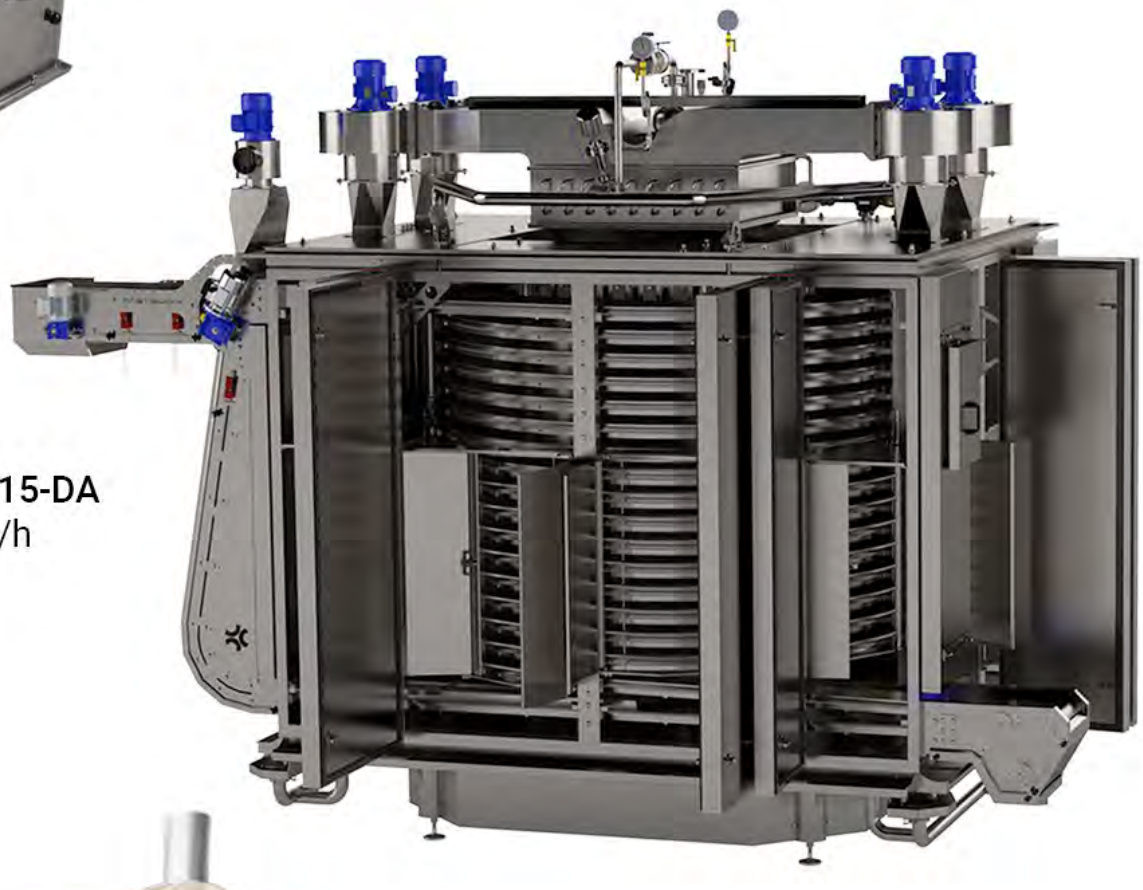

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Table 3 **LENTIL PASTA COOKING BEHAVIOUR**

Sample Red lentils	Cooking time (min.)	Water absorption (%)	Cooking losses (g/100g DM)	Texture (N)	Total work (N*mm)
LR TQ-CONV pasta	6.5	81^{c}	6.3^{b}	668^{b}	3216^{b}
LR CE Pasta		66^{a}	9.4^{c}	548^{a}	2286^{a}
LR PRE-CONV Pasta		77^{b}	5.7^{a}	637^{b}	2938^{b}
LR TQ-CONV Pasta	8.0	92^{B}	7.2^{A}	597^{B}	2907^{B}
LR CE Pasta		87^{A}	9.7^{B}	473^{A}	2201^{A}
LR PRE-CONV Pasta		89^{AB}	7.0^{A}	584^{B}	2830^{B}
Sample Yellow lentils	**Cooking time (min.)**	**Water absorption (%)**	**Cooking losses (g/100g DM)**	**Texture (N)**	**Total work (N*mm)**
LG TQ-CONV Pasta	6.5	78^{b}	7.0^{a}	530^{b}	2448^{b}
LG CE Pasta		76^{b}	7.1^{ab}	609^{b}	2898^{a}
LG PRE-CONV Pasta		74^{a}	7.4^{b}	636^{b}	2763^{b}
LG TQ-CONV Pasta	8.0	93^{B}	7.7^{A}	418^{A}	2125^{A}
LG CE Pasta		87^{A}	7.9^{A}	513^{B}	2468^{B}
LG PRE-CONV Pasta		88^{A}	8.0^{A}	548^{C}	2361^{AB}

The different small letters stand for significant differences at the optimal cooking time ($p<0.05$) (Tukey's HSD). The different capital letters stand for significant differences at the overcooking time ($p<0.05$) (Tukey's HSD).

parison to those for the LR TQ-CONV and LR PRE-CONV pasta.

In order to simulate the resistance of the sample during chewing, a compression-cutting-extrusion test was performed (Table 3). With regard to the analysis carried out after 6.5 min, the LR CE pasta sample had the poorest texture, significantly different ($p<0.05$) from the texture of the LR PRE-CONV pasta and the LR TQ-CONV sample. The poorer texture of the pasta obtained by extrusion-cooking may be associated with greater losses during cooking which can lead to variations in terms of structure. The same behaviour is observed even after overcooking. Also with regard to

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total work, LR CE pasta has the lowest value both for the analysis carried out at optimal cooking time and for that carried out after overcooking; in both cases the sample shows significant differences ($p<0.05$) with the pasta made by the conventional method.
Water absorption and cooking losses analysed in the yellow lentil pasta samples present similar values (Table 3), both at optimal cooking time and after overcooking. The texture is statistically poorer ($p<0.05$) for LG TQ-CONV pasta both after 6.5 min of cooking and after at 8 min of cooking (Table 3), which is indicative of a less compact structure.

Conclusions

Although the pre-gelatinization of the grains involves minimal variations in the characteristics of the amylaceous component, the treatment applied seems to have an effect on the final characteristics of the product.
Specifically, LR PRE-CONV pasta presents the lowest losses during cooking: this could be due to the pre-gelatinization treatment which promoted partial gelatinization of the starch and therefore its reorganization during the pasta-making process, thus limiting the excessive swelling of starch granules during cooking. On the contrary, LR CE pasta has the highest cooking losses, the lowest water absorption, the poorest texture and the least total work. Yellow lentil pasta, on the other hand, shows greater similarities in terms of water absorption and cooking losses. Texture and total work, on the other hand, are greater in the pasta obtained through conventional technology from pre-gelatinized flour, an indication of a more compact structure. Conversely, the LG TQ-CONV pasta shows the lowest values, which might suggest a less close-knit structure.
In conclusion, lentils are a raw material ideal for the production of dried pasta, thanks to their characteristics. All the processes considered produce pasta with a good appearance and good cooking behaviour. However, in the case of red lentils, the extrusion-cooking process on the native flour produced the worst results in terms of cooking and texture losses. Further studies will be needed to assess the relationship between the intensity of the pre-gelatinization process, the changes in the starch and proteins, and the characteristics of the finished product. The study will be completed by an evaluation of the sensory characteristics of the pasta types in order to discover the extent to which they might be acceptable to end consumers.

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4

Pasta in the age of Covid: implications and emerging behaviours

Pastaria Centre for Economic Research

At Pastaria Festival 2020, Nielsen outlined the evolution of the world market, examining its characteristics and considering potential developments in the sector.

A new normal lies ahead. It carries implications, some of which will be familiar following the lived experience of lockdown this past spring, while (many) others are foreseeable, even in a situation dominated by uncertainty and concern over the renewed intensity of the Coronavirus crisis.
In just a short few months, the markets, the economy and consumers have been thrown into historic turmoil, arising from circumstances that have swallowed a few percentage points of global GDP, transforming forecasting into an acrobatic feat.
Presenting at Pastaria Festival 2020 (held remotely this year due to Covid restrictions), the Nielsen measurement and data analytics company looked back on 2019 and provided an outline of the evolution of the world pasta market, examining its characteristics and considering potential directions for the evolution of the sector.
Specifically, monitoring of spending dynamics in 66 countries across the world in the period preceding the health crisis revealed market growth that was significantly more pronounced in terms of value than physical sales, particularly in Europe. Stefano Galli, Intelligent Analytics Director at Nielsen, noted that “global trends over the past twelve months saw 3.8% growth on 2018 in monetary terms (to €9.9 billion). This compares to 1.1% growth in volume terms for the same period, with a total of 5.9 billion kilos of pasta sold worldwide”.
Europe alone accounts for 57% of the global turnover for the sector, representing €5.6 billion. Performance was positive in 2019, with the Old Continent seeing a 4.2% increase in sales. If considered in quantitative terms, however, that growth appears slower and merely fractional (+0.3%). Another 3.3 billion in retail turnover was concentrated in the American continent, representing a 1.5% increase on 2018 pasta sales, despite volumes remaining unchanged, while the combined closing value for the Asian and African markets – areas of very intensive growth, though still marginal in terms of absolute value – totalled one billion euros (0.6 and 0.4 billion respectively).
The success in Europe reflects certain emerging trends, characterised by health-focused and sustainable products, selected origins and innovation, something that applies not only to the product, but also to packaging, technology, flavours and ingredients.
The “during Covid” phase – starting in February 2020 with the introduction of the initial containment measures – marked the beginning of a period of exceptional expansion for all fast-moving consumer goods. This is demonstrated by data collected by Nielsen across Europe’s 10 biggest countries, with the FMCG (fast-moving con-

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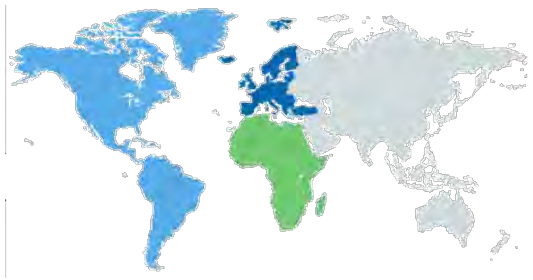
2019 VS 2018 PASTA GLOBAL TRENDS

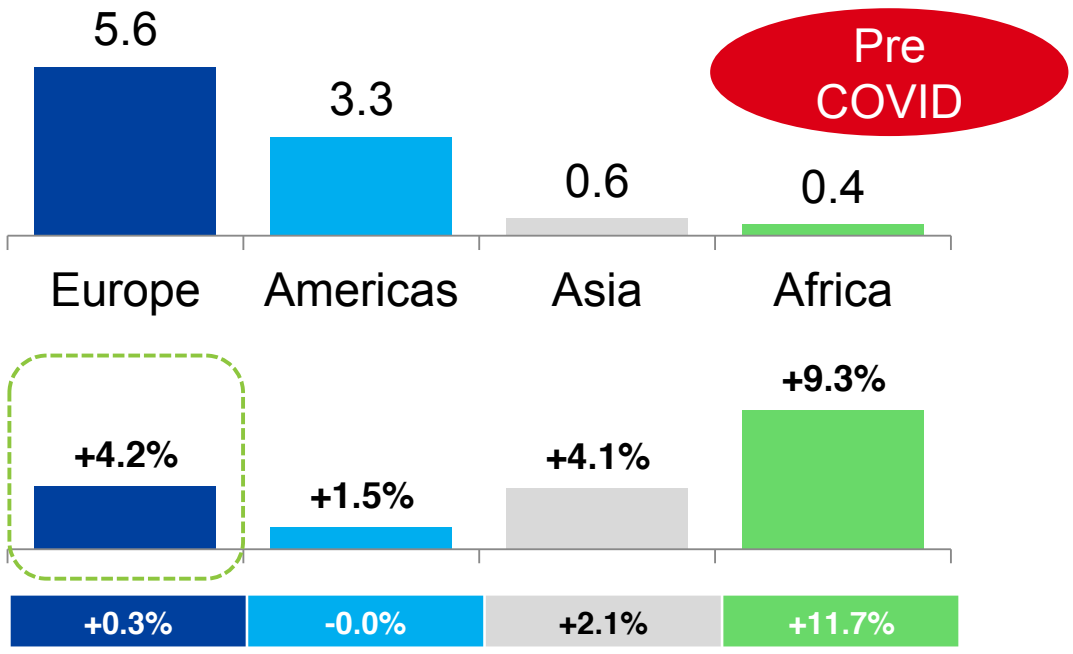
Europe counts for 57% of Global Pasta **FMCG sell-out**, recovering value thanks to evolving offering

Global
Value Sales*
9.9 Billion € (+3.8%)



Value trends

Volume
trends 5.9 Billion kg
(+1.1%)



Source: Nielsen Global Pasta View 2020

* 66 countries FMCG channels sell-out value **2019 vs 2018**

PASTA: EMERGING & WINNING TRENDS

Pre COVID

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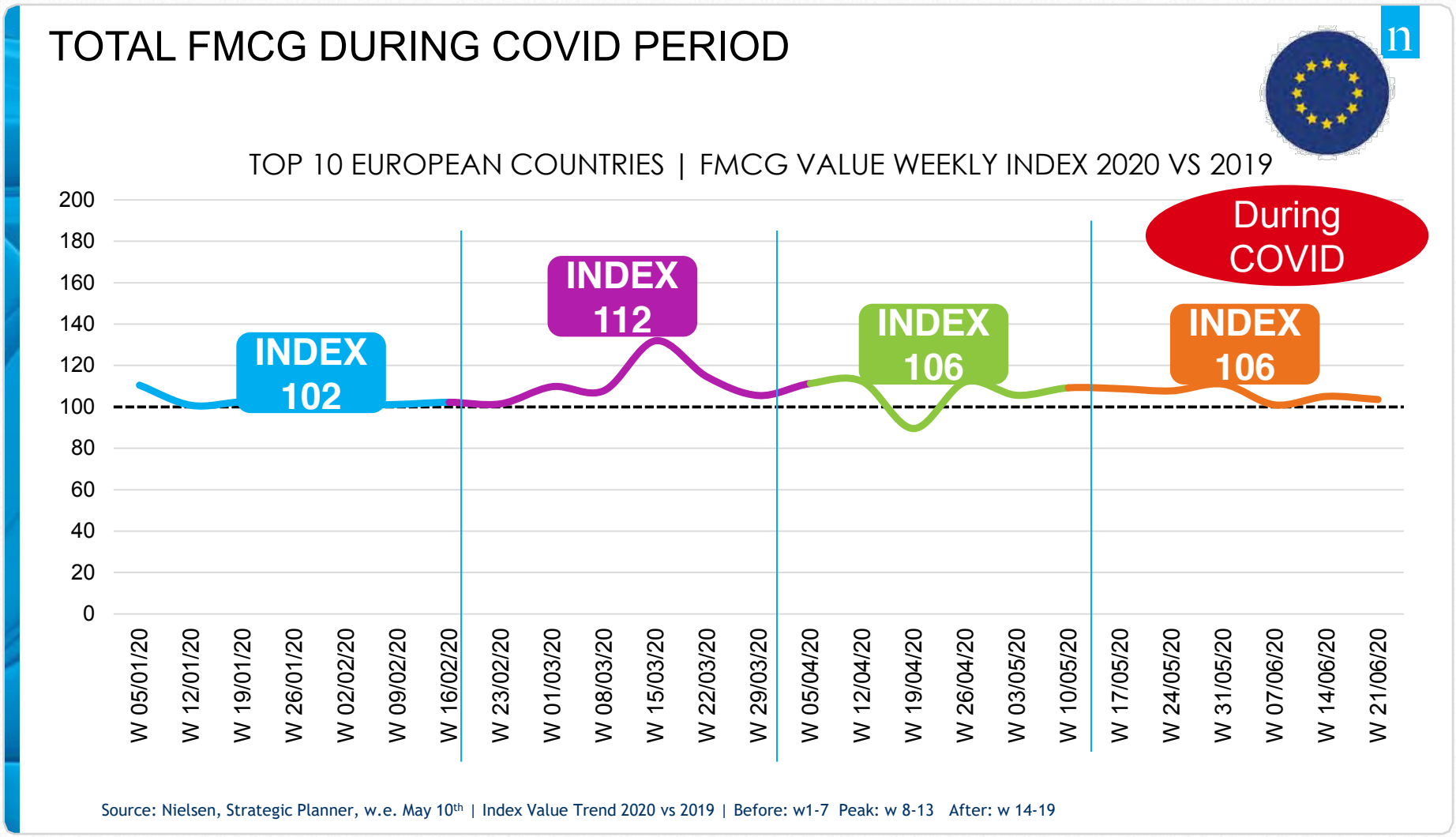

sumer goods) value index jumping, in the height of the lockdown, to 112 – representing 12% growth on a base of 100 – before settling at around 6% as the year went on. Pasta enjoyed a golden moment in this phase, and Italy, Europe's top performer, saw the index for the sector jump to 156 during the peak in March. This performance is obviously at the expense of consumption outside the home. The crisis and forced closures have also provided a strong boost to consumption in the other 9 countries monitored by Nielsen, with the year predicted to end with the purchase index at 104 and a 12-month average that, based on the current situation, indicates double-digit growth for 2020.

As regards the emerging products segment (Free From, Rich In and Organic), the 10 markets monitored saw an increase in sales that was more sustained in terms of value than volume, associated with an inflationary effect more or less across the board, with added value for the category.
In this state of "new normal", it will be necessary to recognise the permanent aspects of changes in consumption, both inside and outside the home. It will also be important to decipher the signs arising from the crisis and understand, in more detail, the implications for pasta producers and others working in various capacities in the market.
The first indicator of a severe downturn is

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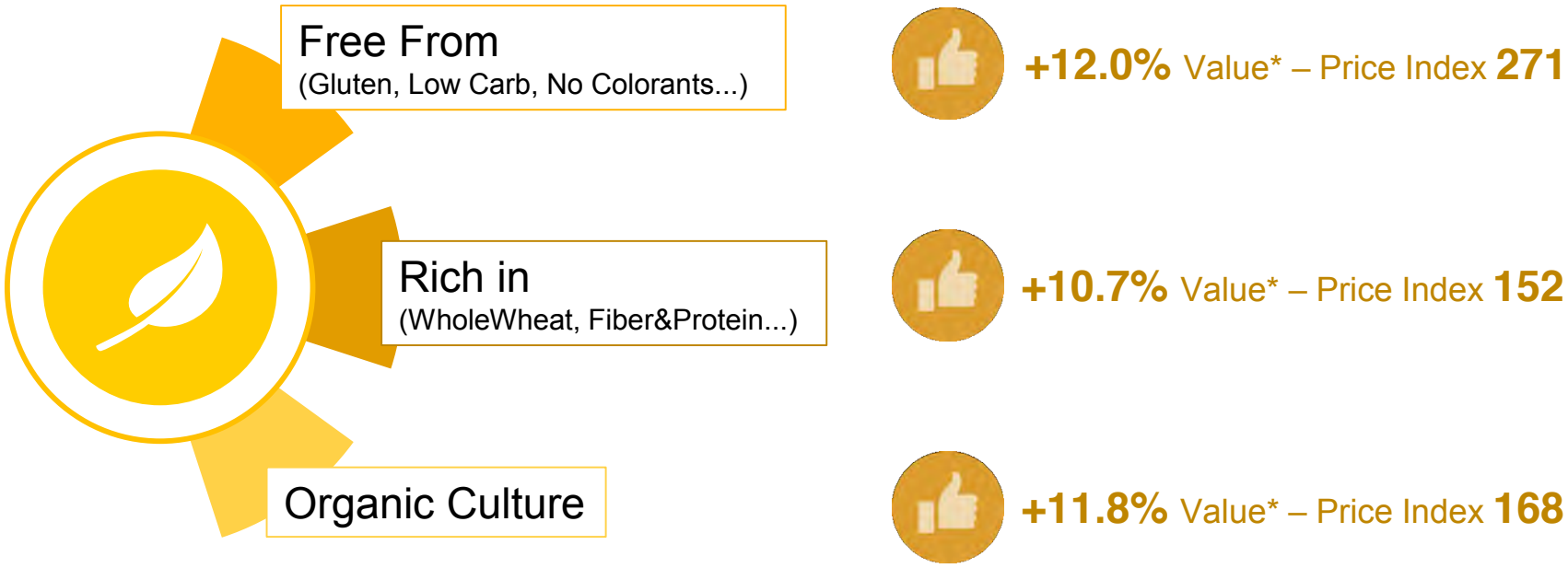
PASTA EMERGING & WINNING TRENDS

Update June 2020

Healthy/Sustainable products are performing very well within different product attributes



Trend confirmed and accelerating

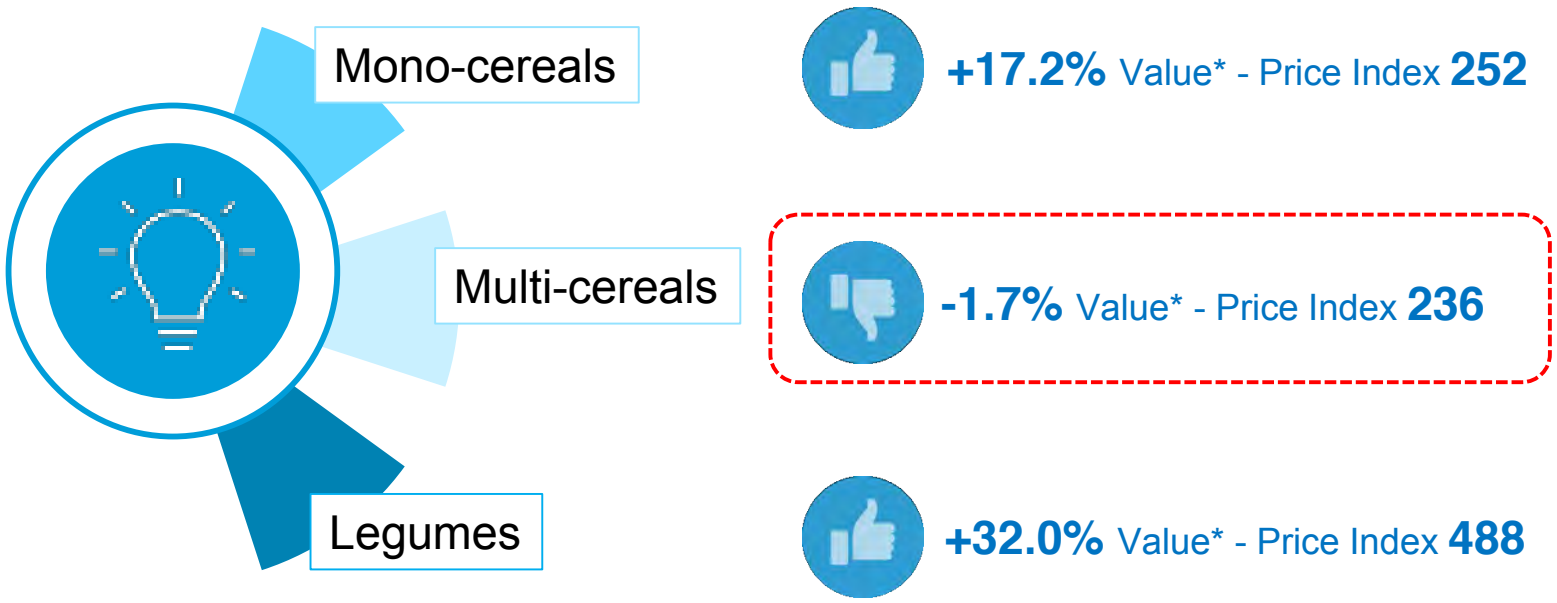
* Source: RMS FMCG Nielsen in Italy, France and Germany (1/4 of Global Sales) – CAGR 2020 vs 2018

PASTA EMERGING & WINNING TRENDS... BEYOND SEMOLINA

Update June 2020

What we can learn from Developed Countries*?

Innovation is about new ingredients... «Other Flours» Dry Pasta is growing with a pace of +14.8% in the last two years (212 mio € yearly sales)



Trend confirmed and accelerating

* Source: RMS FMCG Nielsen in Italy, France and Germany (1/4 of Global Sales) – CAGR 2020 vs 2018

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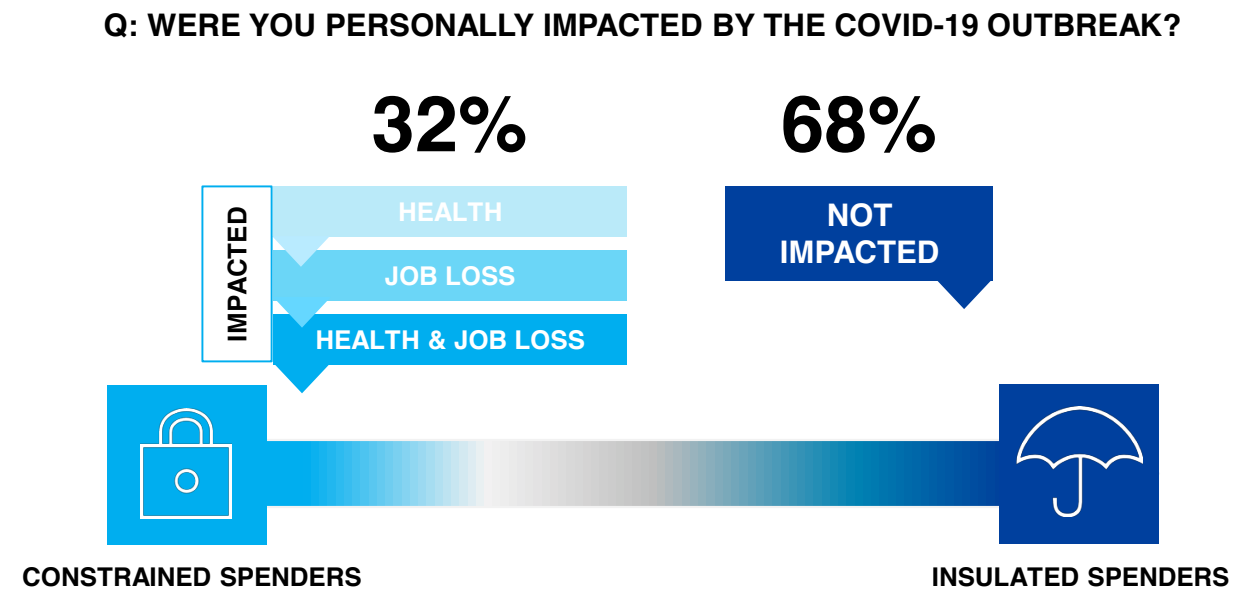
COVID-19 HAS PERSONALLY IMPACTED NEARLY A THIRD OF GLOBAL CONSUMERS, AND THIS IS EXPECTED TO GROW



Source: Nielsen Global Survey "The New Shopper Normal" conducted in May 2020
"Personal impact" includes both the respondent themselves and/or a member of the same household

consumer confidence; this underwent a vertical drop on a global level following lockdown, before settling, in the second quarter of 2020, at a level higher than that recorded at the height of the Great Recession of 2009. It should be noted, however, that an economic crisis is now looming, and seems set to be more acute and profound than that experienced eleven years ago, in spite of stopgap measures introduced by governments through expansionary fiscal policies, and by central banks with ultra-accommodative monetary policies.

This will lead to further erosion of the confidence indicator, with conditions certainly set to worsen in terms of consumer purchasing power, particularly given that the economic crisis is expected to have a considerable impact on employment levels. Emerging trends indicate that home will play a central role, with an increase in remote working and, in general, that shoppers will be more careful about purchasing and consumption, with a view to containing spending.

The impact of the Covid-19 pandemic can be seen in relation to a third of the world's consumers, who now appear more aware of their spending limits. Nielsen's data suggest that 32% of spenders fall into the "constrained" consumer category. These individuals have been affected in some way by changes in health or employment

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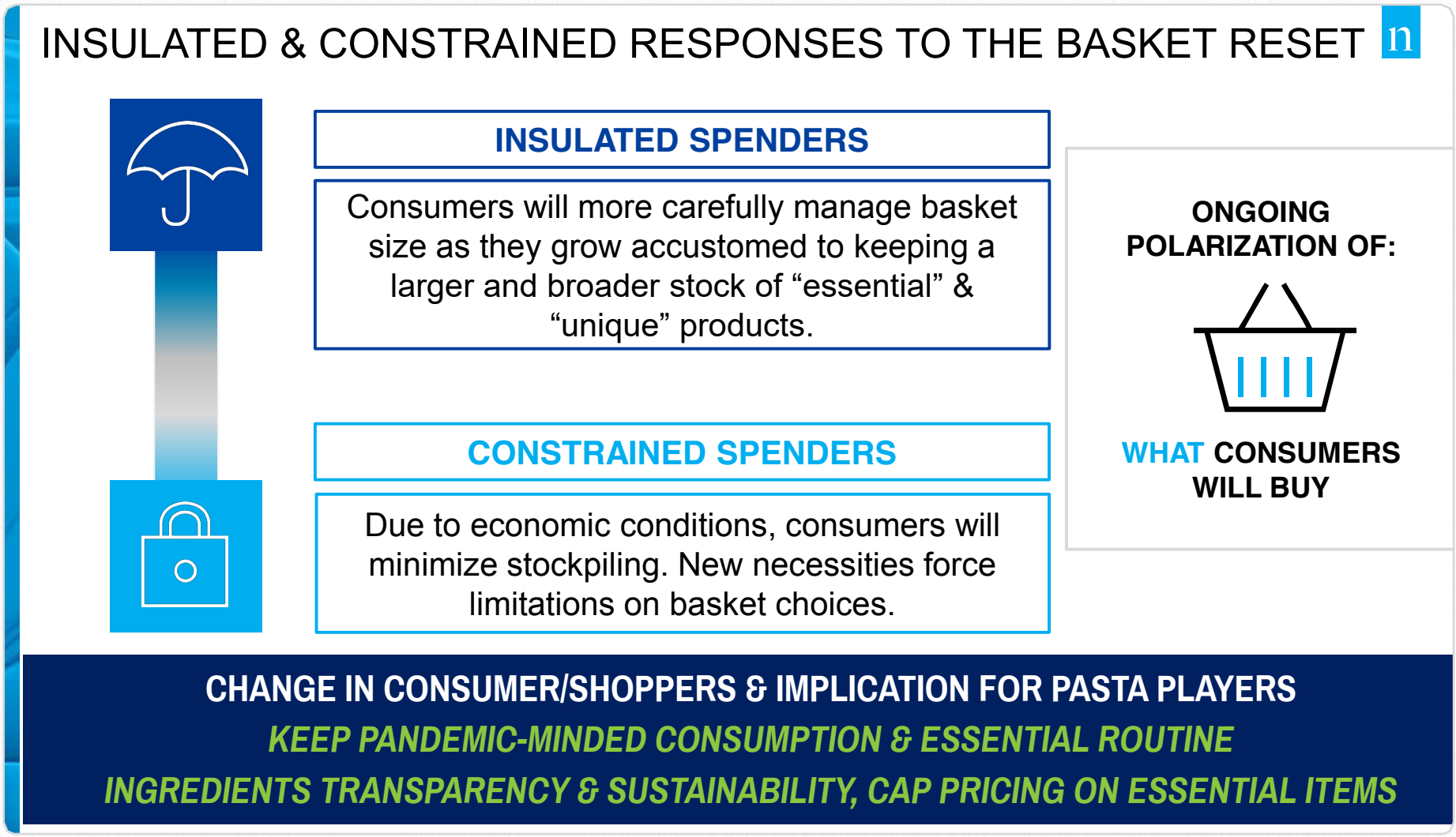

status, or both. The other cluster consists of “insulated spenders” (consumers without particular constraints on their FMCG spending), on whom Covid has not yet had a significant impact. The latter group may in fact find that their purchasing power improves, as a result of a presumably deflationary scenario.

In the situation of polarisation described above, the dynamics between the two groups of consumers may vary based on geographical area. The percentage of European consumers classified as “constrained” is estimated to be 23%, lower than the global average, and a full 15 points lower than the 38% recorded in both North America and all of Asia.

The behaviours associated with the different groups will lead to a rebalancing of FMCG baskets, Nielsen observes. In particular, shoppers who find themselves in greater difficulty are likely to purchase certain items less frequently, and are generally likely to keep a closer eye on spending budgets. Retailers are likely to resort to price-control policies for essential items, including on a large scale. Commercial operators, meanwhile, and particularly large-scale retailers, will respond to the “insulated” group’s spending behaviours by offering new solutions, including with a greater emphasis on indulgence. The latter approach will reflect an attempt to tap into consumers’ pursuit of satisfaction, associ-

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INSULATED/CONSTRAINED RESPONSES TO THE HOMEBODY RESET

INSULATED SPENDERS

More consumers explore and try self-serviced needs to personalize and amplify care and meal solutions at home.

CONSTRAINED SPENDERS

Out of necessity, more consumers rely on self-serviced needs to save on costs.

ONGOING POLARIZATION OF:

WHERE CONSUMPTION WILL HAPPEN

CHANGE IN CONSUMER/SHOPPERS & IMPLICATION FOR PASTA PLAYERS

EXPLORE AND TRIAL NEW PRODUCTS MEAL SOLUTIONS AT HOME, COCOONING ATTITUDE
COST SAVING ATTITUDE EXPECTED TO INCREASE ON ESSENTIAL FOOD TOO
INCORPORATE TECHNOLOGY FOR SHOPPING, INTERACTION AND EXPERIENCE

INSULATED/CONSTRAINED RESPONSES TO THE RATIONALE RESET

INSULATED SPENDERS

Consumers seek luxuries within FMCG to compensate for travel and entertainment they can no longer safely enjoy.

CONSTRAINED SPENDERS

With limited income, each purchase holds greater significance. FMCG is sought to fulfill a broader set of both essential and discretionary needs.

ONGOING POLARIZATION OF:

WHY CONSUMERS WILL MAKE PURCHASES

CHANGE IN CONSUMER/SHOPPERS & IMPLICATION FOR PASTA PLAYERS

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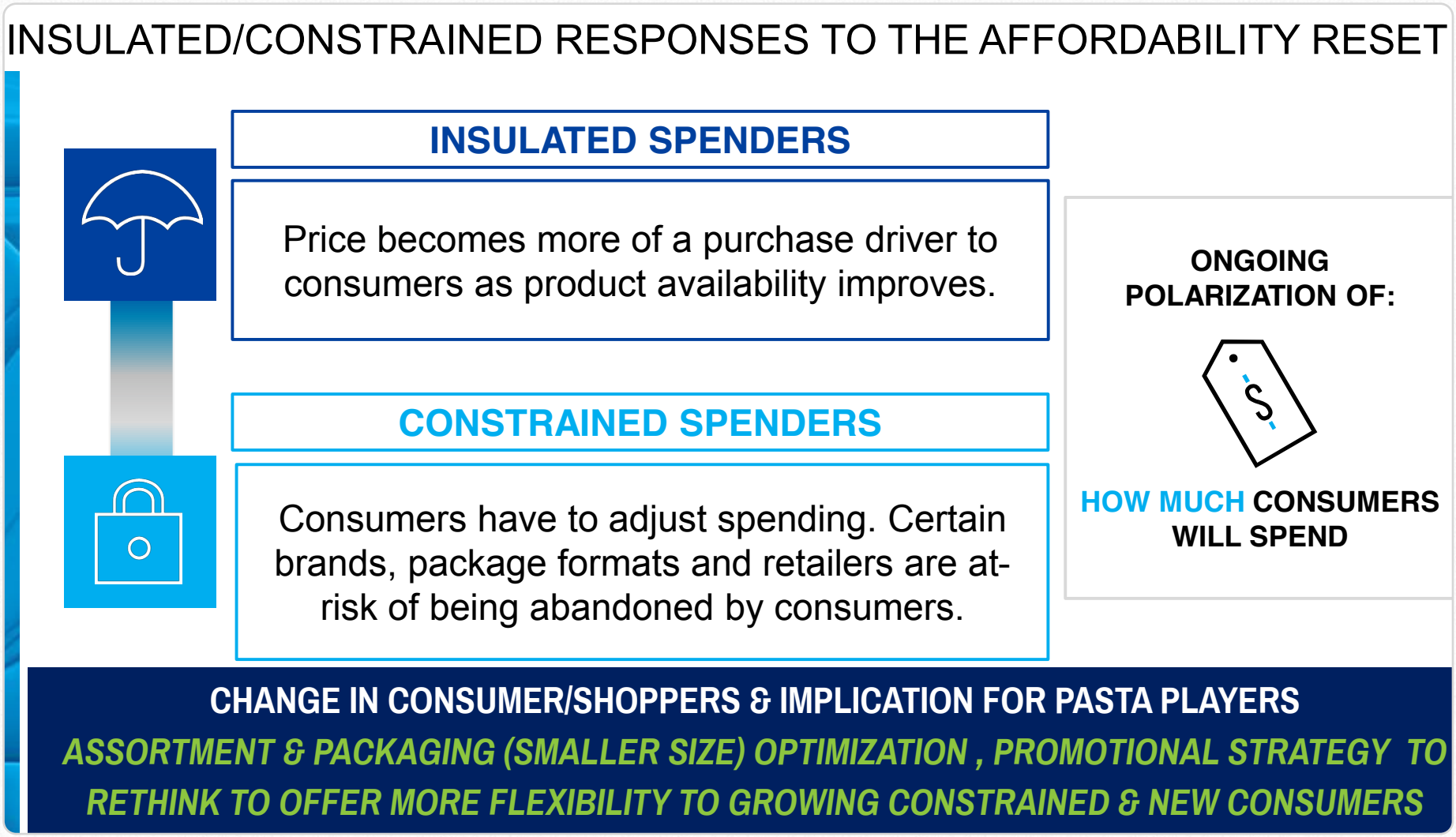

ated both with the domestic context and with the fewer opportunities for consumption outside the home.

In this context, pasta producers, and the food sector in general, must pay greater attention to spending behaviours that, even in traditional sectors, are revealing certain new characteristics. Attitudes and factors that have influenced purchasing for some time are likely to become even more significant, in particular a focus on primary ingredients and the sustainability of products. The latter concern relates to packaging choices and supply chain issues, as well as advertising and promotion at point of sale.

The use of technology, and policies concerning brand promotion and reputational considerations in particular, will play a significant role in bolstering purchasing, both in physical stores and online. It is also worth noting that this state of “new normal” will see the “why” of purchasing changing. Premium products, including in the pasta sector, will grasp the opportunities presented by the behaviours of “insulated” spenders, who have already driven a strong boost in sales in the higher-tier segments. Those putting essential items in their baskets will be less focused on quality, but the effects of such behaviours will presumably be more evident in those sectors that have a greater impact on consumer budgets.

Returning to pasta, ingredient origins and collaboration with local communities are two factors for success; these trends have already been consolidated to some extent, and are likely to further impact shoppers' purchasing decisions. The situation also calls for a rethinking of promotional incentives, however, as well as effort and a greater focus on the rationalisation and optimisation of product mix.

To summarise, strategies will need to be recalibrated on both a company and a sector level. Where possible, this should involve looking at pre-Covid trends and adapting policies to emerging behaviours, without failing to consider the opportunities presented by digital technology.

What lies ahead is an unprecedented future, particularly in light of the current serious resurgence of the health crisis. "The weak signals that we can identify" Galli concluded "can certainly help guide our assessments and decisions, but the phenomena must be monitored regularly, with skill and care and, if possible, anticipated, in order to manage their effects".

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5

Dealing with food phobias. Carbohydrates as a paradigmatic example

Francesco Visioli
University of Padua

The article by Francesco Visioli, speaker at the third Pastaria Festival, contributes to debunk a number of common myths and re-establish the scientific truth about pasta.

Where does the carbohydrate phobia currently pervading today's society come from? I'm writing these lines while on television they are showing an advert for a kitchen tool which makes 'spaghetti' out of vegetables, courgettes in particular, highlighting the fact that this tool can help you avoid carbohydrates. The ad's "payoff" is exactly that, that thanks to this gadget we can rid our diet of carbohydrates.

So, in particular, I will be trying to answer the question as to whether this negative attitude developed towards carbohydrates has any scientific foundation or not. The first thing to underline is that in the field of nutrition, food fads are often spread by word of mouth, advertising, indiscriminate use of the Internet and on the perfectly right ambition human beings have to continually improve their health. All this leads to the proliferation of diets without any scientific-health basis. The latest examples are high-protein diets, high-fat/low-carb ketogenic diets, diets that include prolonged fasting, diets that involve drinking large quantities of liquids, diets that skip the evening meal, etc. Coming more specifically to the field of carbohydrates, the pseudoscientific bases on which these diets are advocated suggest that a high consumption of these macronutrients leads to a greater probability of becoming overweight and obese (if truth be known, calculation of the total number of calories should be considered). To this we must add the theory, actually founded on biochemical bases, that associates the consumption of simple sugars and complex carbohydrates with insulin secretion: rapid insulin secretion is genuinely associated with a higher inflammatory state and we know that inflammation is at the basis of almost all chronic degenerative diseases.

That said, it should be clear to readers that the highest longevity rates in the world are enjoyed by populations who base their diet primarily on carbohydrates such as wheat, rice or corn. If we look historically at the evolution of diets, those populations that follow a Mediterranean or Japanese diet have always had (and continue to have) the longest life expectancy. These people derive most of their calories from wheat and rice respectively. Another aspect that must be clear to Pastaria readers is that it is very difficult to test humans for the long-term effects of a particular type of

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diet. Clinically verifying whether it is better to eat low-carb, high-protein, high-carb, low-fat or high-fats, etc. is practically impossible because we cannot lock people in specialized facilities and keep them there for decades, the time it takes for degenerative diseases to develop. The only alternative is to recommend diets of different macronutrient content and measure, over relatively short periods of time, some markers called surrogates. These markers allow us to hypothesize (but not prove!) greater or lesser risks of developing certain pathologies. The other thing that we can measure relatively easily are increases and reductions in body weight. We know that being overweight and obesity are very important risk factors in the development of various illnesses, especially cardiovascular disease and cancer.

In brief, the few intervention studies available to us reveal two things: one is that with any type of diet, any initial weight loss is eventually regained. The second is that no major differences are noted between those who eat a lot of carbohydrates and those who eat very few when diets are studied under controlled conditions.

In this regard, perhaps the most relevant study – called DietFits (Diet Intervention Examining The Factors Interacting with Treatment Success) – was conducted by CD Gardner and collaborators, published in JAMA (The Journal of the American Medical Association) in 2018. In this work, researchers assigned a low-fat diet to 305 volunteers and a low-carb diet to another 304. Not being able to lock participants up in a metabolic ward for the duration of the study (one year), a team of nutritionists and dietitians followed the regularity of the diets by calling the participants often and giving them questionnaires. The results show that after one year of following these two diets there was no difference between the two groups in terms of weight loss or other markers of cardiovascular disease. Also in this case we must underline however, that despite adherence to the diets being verified by the intervention of health specialists, on the whole we must trust the declarations made by the participants.

Among other things, we must also repeat that although being overweight and obesity are very important risk factors, the idea of intervening only on the weight aspect to enhance health effects on important diseases is scientifically wrong. A similar misunderstanding is seen with cholesterol: dietary changes to reduce cholesterolemia are certainly very important but do not predict a 100% better prognosis in terms of cardiovascular disease. In summary, any type of diet that reduces a person's weight is probably an effective diet in terms of prevention, but we cannot with all

certainty attribute sensational health benefits to these types of intervention since many risk factors contribute to the main diseases.

Another study worth mentioning was conducted by Seidelmann and collaborators and recently published (2018) in the Lancet Public Health. In this study, researchers measured the consumption of carbohydrates by 15,428 adults followed for 25 years; the conclusions of which are clear: the nadir of mortality, i.e. the lowest point of deaths registered, occurs when carbohydrate consumption represents 50-55% of consumed calories. Excessive consumption, but also too low consumption, are associated with greater mortality for all causes. Among the main limitations of this study is the method used to measure carbohydrate consumption, by distributing specific questionnaires and, therefore, trusting what the volunteers reported. Nonetheless, the high numbers involved in this study make it reliable. It should also be noted that reduced carbohydrate consumption is replaced by a high consumption of animal proteins and fats, further associated with high mortality in this research.

To conclude, and in answer to the question posed at the beginning of this piece, it is not clear where this carbo-phobia pervading today's society comes from. What we do know is that it has no scientific basis. On the contrary, it can cause dangerous dietary imbalances, the long-term effects of which are still unknown. Until scientific research proves otherwise, it is advisable to keep the consumption of carbohydrates (pasta, rice, potatoes, corn, etc.) at between 45 and 60% of daily calorie intake, also consuming as many vegetables as possible.

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