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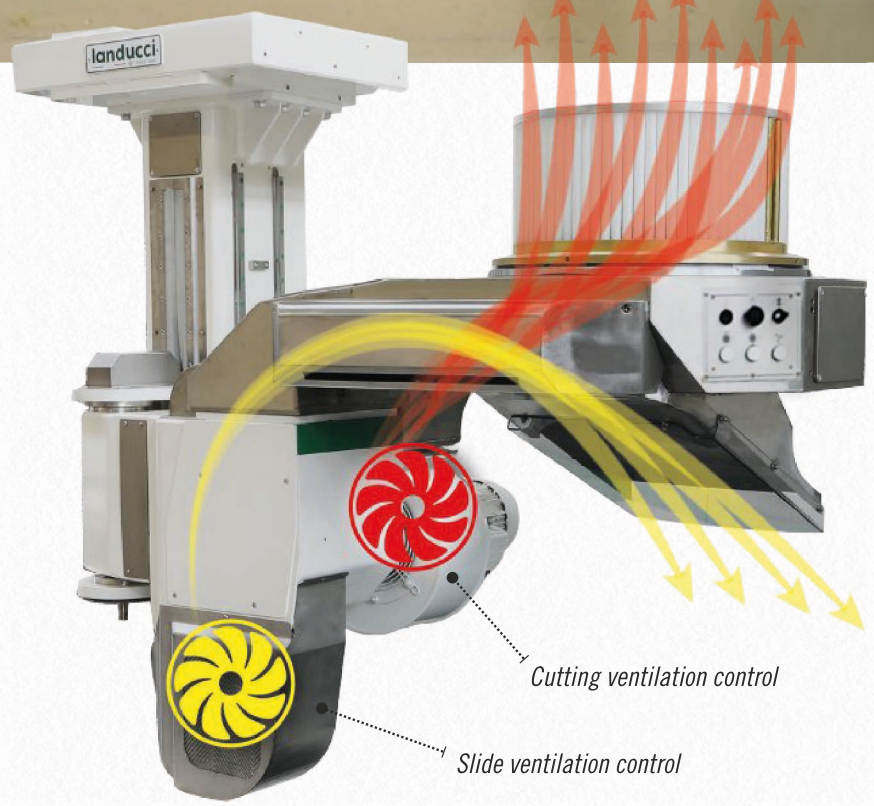

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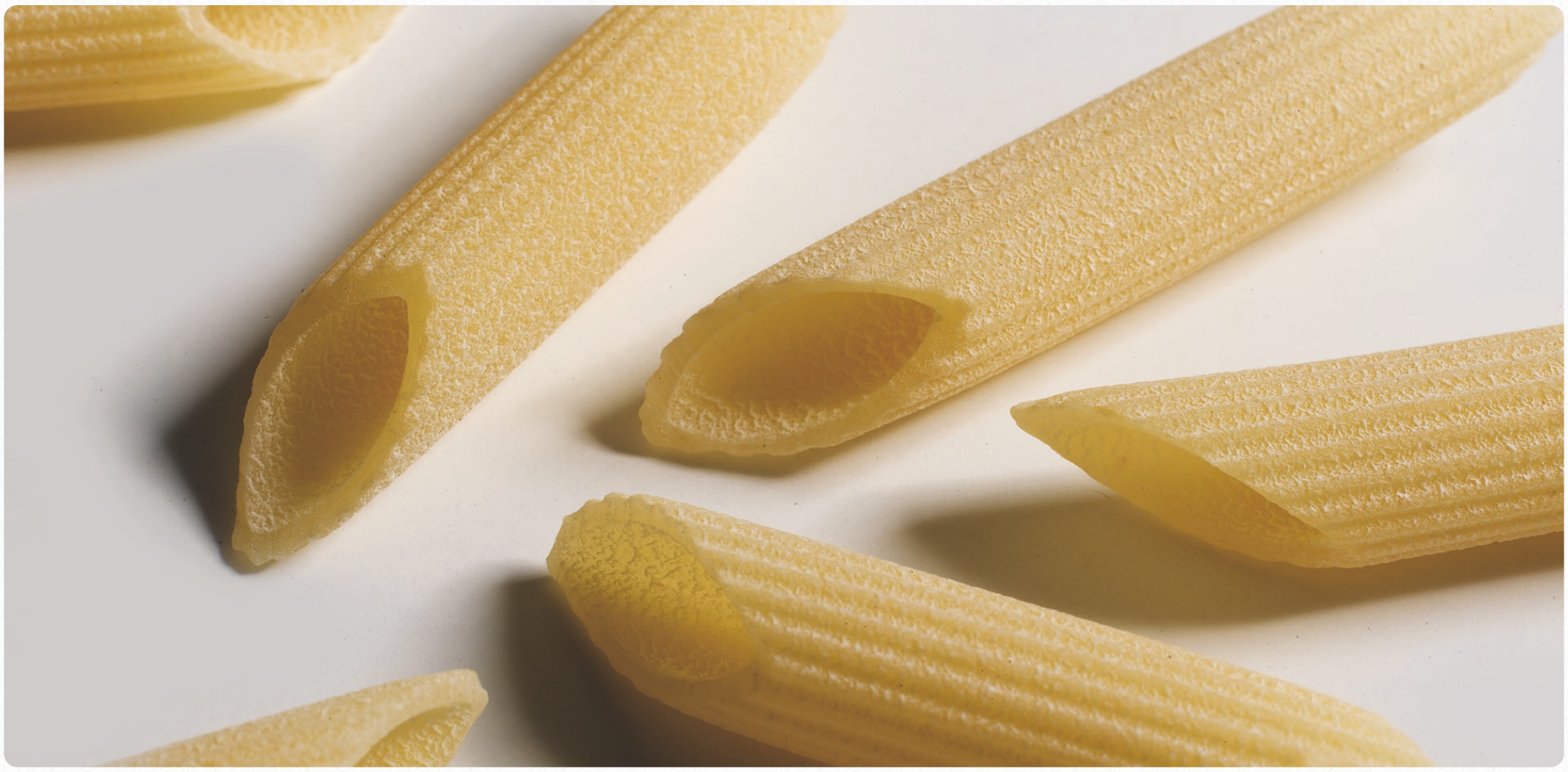

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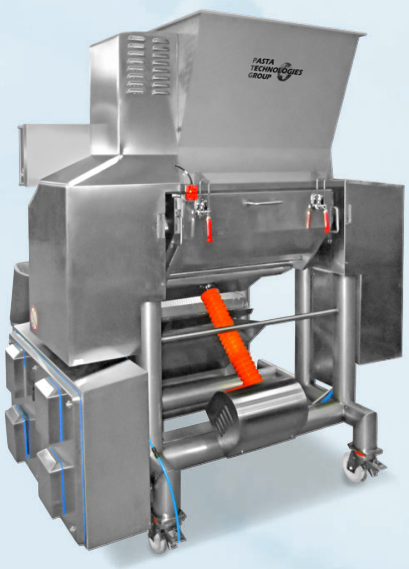

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1

Pasta with spelt: it’s all in the label

Lino Vicini

Use of the correct sales denomination and ingredient indications for pasta made with spelt appears to be far from straightforward, if the current regulations in Italy are anything to go by.

Italy has a long tradition in the making of pasta.
With the passing of time, this sector has also come under the scrutiny of the lawmakers.
Article 1 of Law No. 874 of 22 June 1933, on the regulations governing pasta, stipulated that dried pasta, in its various forms, made exclusively with semolina obtained from the milling of wheat, had to be marketed and sold under the name '*pasta di pura semola*' (pure semolina pasta) using durum wheat semolina.
Products made from soft wheat flour, on the other hand, could be marketed under the name '*pasta comune*' (common wheat pasta).
These two types of pasta had to be kept distinct and separate in the sales outlets and had to be provided with special tags bearing the name of each of the two types of product.
The subsequent Law 580 of 1967, entitled "Regulations governing the processing and marketing of cereals, flour, bread and pasta", incorporated the existing obligations requiring that pasta intended for sale should only be produced in the types and with the characteristics indicated.
In particular, Article 28 defined as "durum wheat semolina pasta" and "low grade durum wheat semolina pasta" the products obtained by drawing, rolling and drying doughs prepared, respectively, and exclusively
a) with durum wheat semolina and water;
b) with low grade durum wheat semolina and water.
The regulations currently in force pertinent to this discussion are contained in Article 6 of Presidential Decree No. 187 of 2001.
The decree in question contains the "Regulation for the revision of the standard on the manufacturing and marketing of flour and pasta, in accordance with Article 50 of Law No. 146 of 22 February 1994".
The regulation incorporates and partially extends the above-mentioned provision.
This means that in Italy dried pasta may only be produced with three ingredients: durum wheat semolina, low grade durum wheat semolina or durum wheat wholemeal semolina.
With this limited range of choice, the aim of the national legislature was to impose a high quality standard for pasta.

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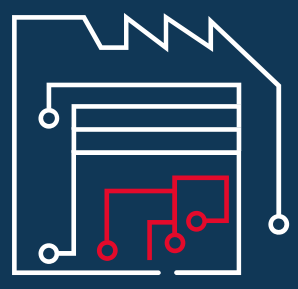

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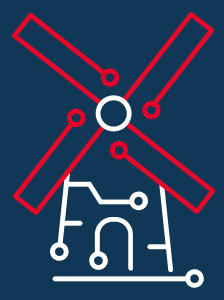

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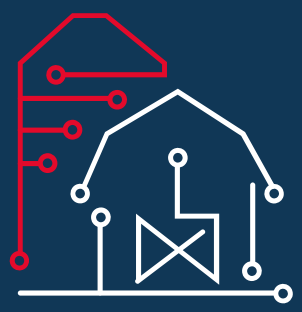

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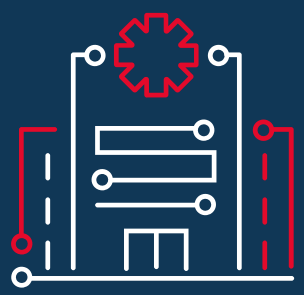

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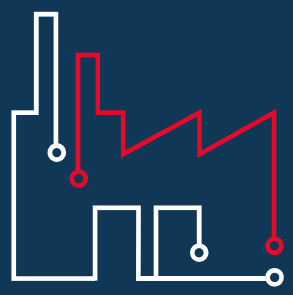

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Sector operators named this set of regulations with the evocative term “Pasta purity law”, recalling the famous German “*Reinheitsgebot*” dating back to 1516, that governs the production of beer in Bavaria.
Given the strictness of the standard in abstract terms, it does not appear possible for an Italian producer to use the simple term “pasta” to describe a product that has not been made with the three main ingredients mentioned above.
A few years ago, in response to a reader’s question, we examined a legume-based product for coeliacs presented in the traditional pasta format.
The answer given at the time, on the basis of the above-described regulations, was that it was not legal to use the term “pasta” for a host of reasons.
Now, some years later, the new question concerns the possible use of the term “pasta” to describe a product made with spelt.
Let’s not forget that spelt was the first cereal cultivated in Tuscia and Lazio, and that it became the favourite food – and for a very long time the daily fare – of the Etruscans and the Ancient Romans.
Indeed, one of the oldest Roman laws decreed that prisoners or slaves were entitled to a pound of spelt a day.
It is helpful to clarify that the term “spelt” refers to three different species of the *Triticum* genus:

- small spelt or monococcum;
- medium spelt or dicoccum (simply called spelt);
- large spelt (*Triticum spelta*).

Small spelt is the most ancient of the three and was the first type of wheat cultivated; the earliest evidence of crops in modern-day Turkey dates back to the 8^{th}-7^{th} millennia BC.
The cultivation of medium spelt followed on the heels of small spelt.
Spelt is famous for being the staple food of the Roman legions. The cereal was used to make bread, *focaccia* and *polenta*.
The importance of spelt in the civilisation of Ancient Rome is borne out by the fact that there was an ancient marriage ceremony called *confareatio* because it featured the bride and groom eating focaccia made of spelt (”far” in Latin).
Over the centuries, the cultivation of spelt declined, supplanted by soft wheat, a descendant of large spelt, and by durum wheat, a descendant of medium spelt, because the latter crops had higher yields and lower processing costs.
Coming to the present day, the use of spelt in addition to durum wheat semolina has increased over the years.
There are two main problems concerning these products, which can be summarised as follows:

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- What is the correct name of the food?
- How should spelt flour be indicated in the list of ingredients?

The first problem brings to mind the famous declaration of the jurist Javolenus who, as far back as the end of the first century A.D., maintained that "*Omnis definitio in iure civili periculosa est*" (Digesto 50,17,202).

Presidential Decree 187 of 2001, as we have mentioned, deals mainly with durum wheat semolina pasta, but not to the exclusion of fresh pasta made with soft wheat, which is also governed by this decree.

No express provision of Presidential Decree 187 of 2001 dictates that the term "pasta" can only be used for products made from durum wheat semolina.

Indeed, the Court of Justice of the European Union, in its ruling on Case 90 of 1986, established that "the Italian legislature uses the term "pasta" to designate products made from soft wheat or a mixture of soft and durum wheat, i.e. fresh pasta and pasta intended for exportation". Furthermore, the term "durum wheat semolina pasta" refers to a particular type of pasta, which attests to the fact that the term "pasta" has a generic meaning and does not imply that only durum wheat is used in manufacturing".

That the term "pasta" is, in itself, a generic description is also demonstrated by the fact that there are totally different products on the market, such as "*pasta di acciughe*" (anchovy paste) and "*pasta di mandorle*" (almond paste).

It should also be noted that, in recent years, supermarket shelves have begun to fill up with corn and rice pasta, which resembles durum wheat semolina pasta in many ways but is intended for gluten-intolerant consumers.

Notwithstanding the above rather trivial considerations, the use of the term "pasta" for a dried product made from spelt would not be advisable for a variety of reasons. "Food specialty" would be a more appropriate term.

First and foremost, the use of the term "pasta" could create confusion in consumers, who need to be properly informed on the product they are about to purchase.

And it is, in fact, clear that the term "pasta" refers to durum wheat pasta, so spelt pasta could lead to confusion among consumers.

Another foodstuff similar in format to durum wheat pasta are Pizzoccheri della Valtellina.

This product, which is a variety of pasta made from buckwheat flour mixed with other flours, is not formally referred to as

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SUGGESTED APPLICATIONS

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"pasta" and is not, therefore, covered by Presidential Decree 187 of 2001.
The Decree of the Ministry of Agriculture dated 26 July 2017, that introduced the obligation to indicate the origin of the durum wheat used for the production of durum wheat semolina pasta products, applies exclusively to the products governed by Presidential Decree 187 of 2001.
The parameters of the flours used for the production of durum wheat pasta are different from those of spelt flour.
The text of Presidential Decree 187 of 2001 refers to semolina, pure and simple, and concerns that obtained from durum wheat with precise protein and ash indices.
The raw materials and finished products are, therefore, objectively different.
It therefore appears evident that they should be differentiated also in terms of denomination.
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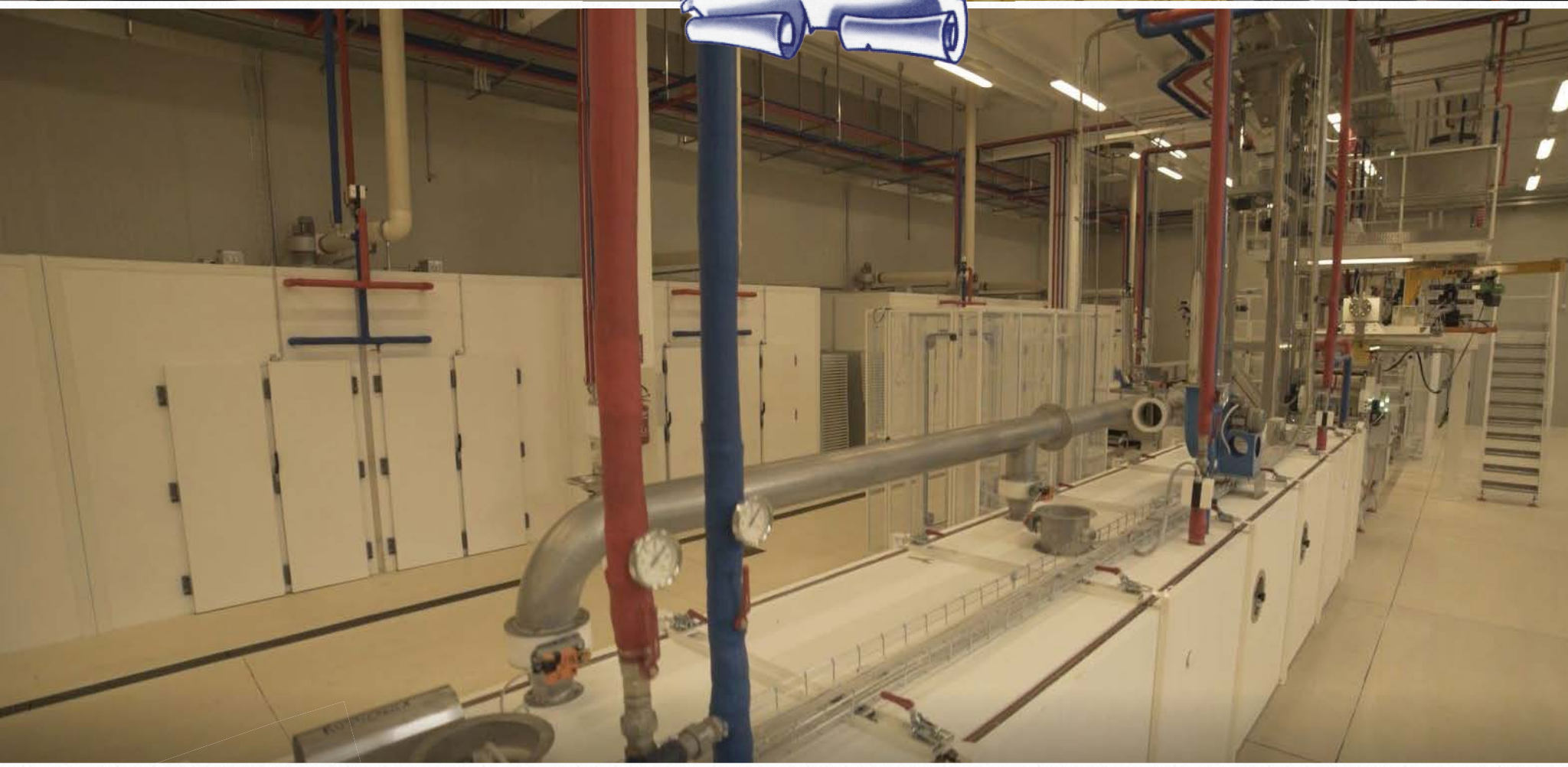
question, namely the indication of spelt flour in the list of ingredients of the product in question, the same doubts emerge.
According to the Italian dictionary, the terms “semolina” or “*semolato*” refer to durum wheat and therefore the use of these terms could be criticised for being potentially misleading.
To conclude the discussion of this topic, however, it should not be forgotten that in recent years the term “pasta” has, to all intents and purposes, been “legitimised” by the Italian Public Authorities themselves.
In fact, with the circular dated 22 July 2016, the Ministry of Economic Development in agreement with the Ministry of Health and Agricultural Food and Forestry Policies deemed it lawful to use the term “gluten-free pasta” accompanied by the wording “specifically formulated for people intolerant to gluten” to indicate pasta prepared with deglutenised raw materials and/or flours, including their by-products, other than wheat.
This circular gave the go-ahead to gluten-free corn or rice pasta.
However, this aperture does not resolve any doubts remaining on the applicability of Presidential Decree 187 2001 to spelt flour.
In fact, the provisions contained in Article 6 were designed exclusively for dried pasta, which must, of necessity, be made from semolina or durum wheat semolina, whereas the use of soft wheat flour is permitted for fresh pasta, which can, therefore, be made from a mixture of durum and soft wheat flour.
All things considered, it would be expedient and advisable for a competent Ministry to intervene with authority and clarify the situation by means of an express provision, as occurred in the case of gluten-free pasta for people who are intolerant to gluten.
The ideal solution would be to introduce a legal denomination for the new products so as to avoid clashes and doubts in relation to the existing legislation.
Both the sector manufacturers and consumers of these particular foods would stand to benefit in equal measure.

L.T.A.



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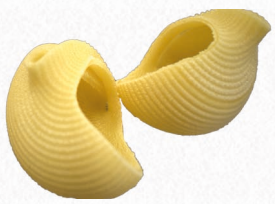

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2

The National Pasta Association to Increase Member Categories in 2021

National Pasta Association
Press release

Carl Zuanelli, Chairman of the National Pasta Association; founder and President of the American pasta factory Nuovo Pasta Productions

With goal of expanding membership, the trade Association will add Foodservice and Retail categories to membership roster.

The National Pasta Association (NPA), the leading trade association for the U.S. pasta industry, is seeking to expand its membership reach in the coming year and beyond. The goal behind this expansion is to create a larger, more engaged NPA membership that is comprised of a diverse range of pasta industry representatives. Current membership categories within NPA include Manufacturing (pasta producers), Milling (flour and grain producers), and Associate (allied products, supplier and service providers and entities with an interest in pasta).

“NPA leadership wants to expand the organization’s reach and influence within the pasta industry and believes the more diverse and inclusive our member base is, the more knowledge we can all collectively gain,” said Carl Zuanelli, Board Chair of NPA, President and Founder of Nuovo Pasta. “We plan to do this by increasing membership for dry, fresh, and frozen pasta, including international and associate membership, and of course, exploring new membership categories.”

The new membership categories will include companies in the foodservice and retail sector.

Foodservice Category

Those who prepare, deliver and serve prepared and ready-to-eat foods by consumers, including, business and industry (B&I), distributors, major restaurant chains, and individual restaurants.

Retail Category

Those who sell goods to the consumer in small and/or large quantities, including grocery chains and stores, club stores, wholesalers, and other retail stores.

Companies joining these new membership categories will have access to NPA’s incredible benefits, including:

- the ability to increase education and understanding of the pasta industry through NPA communications, educational webinars and attendance at the NPA Annual Meeting;

NATIONAL PASTA ASSOCIATION

Annual Meeting | October 17 – 19, 2021

2020 has been a year of change, and our 2020 Annual Meeting was canceled due to the risks that COVID-19 posed on an in-person meeting.

As the NPA Member Education Committee began to plan for 2021, the current state of the country, member safety and comfortability had to be taken into consideration. After much deliberation, the NPA Board of Directors has made the decision to postpone the NPA 2021 Annual Meeting from its originally scheduled dates of March 21 – 23 to October 17 – 19, 2021 to allow for an in-person event in Florida.

The meeting will be held in the same hotel, the Ponte Vedra Inn & Club in Ponte Vedra Beach, FL, and registration rates from the March 2020 meeting will be rolled over and applied to the new October dates for those who had previously registered.

On a positive note, this allows us to be together during National Pasta Month and celebrate National Pasta Day (October 17) in person! More information about registration will be forthcoming in a few months.
We are excited to see you in October!

- access to networking opportunities, including connecting with top executives and leaders from all segments of the industry, in order to expand business and build relationships with manufacturers and others in the industry;
- an open invitation to get involved with NPA's forums, meetings and promotions;
- consistent and frequent updates on public affairs work and nutrition updates through various communication methods, including NPA's Pasta Journal and Pasta Bytes;
- a company profile to announce your membership to NPA that will be featured in the Pasta Journal member e-newsletter;
- ability to participate in telling pasta's story through a consumer communications campaign focused on increasing the overall consumption of pasta.

"We are thrilled to be able to welcome new members and new member categories to the National Pasta Association," said Delia Murphy, Executive Director of NPA. "Not only will it add unique perspectives to our current membership, but it will better equip our organization as a whole to understand and communicate the story of pasta in the U.S. and around the world."

The National Pasta Association will also be adding industry contributor categories in 2021as non-formal members. These will include Industry Experts and Ambassadors. For additional information about becoming a member of NPA, please reach out to Elizabeth Katsion at ekatsion@kellencompany.com or info@ilovepasta.org.

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3

Commodity price observatory 1/2021

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Pastaria’s four-monthly feature on the prices of the main raw materials used by pasta manufacturers.

As we emerge from the rubble of 2020, a year that saw the global pandemic crisis triggering the worst GDP contraction since the end of the Second World War, few signs of recovery are expected in the short term.
The consensus among leading international analysts suggests that 2021 will offer little opportunity for recovery (we will need to wait until 2022 for more promising signs), with global macroeconomic development tied up with the progress of the vaccination programmes and, crucially, the real prospect of access to those vaccines.
In that regard, divergence between industrialised and developing countries will be an initial element of significant discrimination that, among other things, will have a considerable impact on the capacity for economic recovery.
The dichotomies evident between the various scenarios, according to the analysts, also reflect a clear advantage held by certain countries in terms of overcoming the crisis. Foremost in this regard is China, which is ahead of the West in the process of returning to normal, post-COVID, with the resumption of production and employment activities. It is hoped that this process occurs, both in Asia and in other parts of the globe, in a manner underpinned by more socially inclusive, environmentally sustainable models.
China's economy – the big winner, together with South Korea and Indonesia, in terms of performance in the fourth quarter of 2020 – is predicted to experience 8% growth over the twelve-month period ahead, driven also by the new free trade agreement signed with the Pacific area, and solid investments in the digital and infrastructure spheres.
As regards Italy, the 209 billion made available as part of the Next Generation EU plan and, above all, the way that funding is used, are the only elements with the potential to boost production and business, capable of breathing a little life back into the national economy.
In this context, which has also seen the speculative and financial world play a not-insignificant role, agrifood commodities have performed far better than expected, particularly in the second half of 2020, with double-figure growth.
Such phenomena are also contributing to fuelling spiralling inflation in the sector, recorded in a number of countries, including Italy, where the food inflation trend is over 1% (December ISTAT data on consumer price trends). This is a significant departure from the general deflationary trend, mainly attributable to the negative effect of the energy sector,

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Fine durum wheat from North Italy	Price (€/ton)	Monthly variation	Annual variation	Forecast
	299	0.8%	16.1%	▼
00 type common wheat flour	Price (€/ton)	Monthly variation	Annual variation	Forecast
	440	0%	8.6%	▲
Semolina above min. leg. req.	Price (€/ton)	Monthly variation	Annual variation	Forecast
	496.83	-0.1%	11%	▼
Eggs M	Price (€/100 pcs)	Monthly variation	Annual variation	Forecast
	14	0.1%	2%	=
Pork hams for Prosciutto 12 kg and over	Price (€/kg)	Monthly variation	Annual variation	Forecast
	3.13	-3.7%	-18.3%	▼
Beef – veal meat half-carcass, prime quality	Price (€/kg)	Monthly variation	Annual variation	Forecast
	5.06	1%	-2.1%	=
Raw milk	Price (€/100 kg)	Monthly variation	Annual variation	Forecast
	35.13	-0.9%	-17.3%	▼
Centrifuged butter	Price (€/kg)	Monthly variation	Annual variation	Forecast
	3.36	-1.5%	-6.7%	=
Grana Padano aged for 9 months or more	Price (€/kg)	Monthly variation	Annual variation	Forecast
	7.4	4.5%	2.4%	=
Extra virgin olive oil	Price (€/kg)	Monthly variation	Annual variation	Forecast
	4.8	0%	50%	=

Source: Centro Studi Economici Pastaria elaboration based on various data sources. Grain, flours and semolina: Granaria, Bologna; Eggs: CCIAA, Forlì; Pork and beef: Commodity Exchange, Modena; Milk, butter and Grana Padano: Commodity Market, Milan; Olive oil: CCIAA, Bari.

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PRICE MONITORING				
FAO Food Price Index	Price (2014-2016=100)	Monthly variation	Annual variation	Forecast
	107.5	2.2%	6.4%	▲
Soft Red Winter FOB US Gulf port	Price (USD/ton)	Monthly variation	Annual variation	Forecast
	247.95	1.1%	10.9%	▲
Mais, U.S. No. 2 Yellow FOB US Gulf port	Price (USD/ton)	Monthly variation	Annual variation	Forecast
	190.38	1.9%	14%	▲

IMF Food Price Index, Soft Red Winter, Mais: November 2020

reversing the high cost of living over the past eight months.

The V-shaped price curve associated with raw materials for the food industry, confirmed by the FAO Price Food Index, is a clear indicator of the net change in direction in this regard for commodities in the sector.

Significant, in this context, are the year-end peaks in vegetable oil prices, reaching their highest levels since September 2012. But equally significant are the 29-month record reached by the dairy subindex, the price escalation on the international sugar markets (with values hovering around their highest points since February, and with further tensions expected) and the major boost in grains, up approximately 20% over the course of one year, marking the highest peak since June 2014.

In this context, wheat export prices consolidated the growth trend, reflecting strong pressure in terms of demand on international markets, and the deterioration of the outlook with regard to new harvests, particularly in South America. Corn and soya prices also performed strongly, boosted by China’s bumper appetite and sub-optimal growing conditions south of the Equator.

It should be noted that the global demand for agricultural commodities is strongly influenced at the moment by China’s breeders replenishing their pig stocks, decimated as a result of the African swine flu epidemic.

Another point to consider is the speculative aspect referred to above, which is contributing to fuelling tensions on the soft commodity markets. The massive injection of liquidity into the financial system from the prolonged expansionary phase of the global

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monetary policy has extended the scope of action of hedge funds, giving rise to the risk of financial bubbles, with implications for the real economy.

As regards durum wheat, a key product for the pasta industry, a second price recovery was followed, before Christmas, by a renewed easing of tensions, reflecting a drop in demand in the milling industry and greater pressure at the borders in relation to foreign wheat, particularly from Canada. The forecast increase in crop sowing in 2020 should also be viewed in the context of a bear market, with the next national durum wheat harvest expected to reach 4.2 million tonnes (estimates by Coceral, European trade association), corresponding to year-on-year growth of 8%.

According to the World Bank, international markets for all cereals should see progressive price stabilisation, while the twelve-month period will see further inflation for vegetable oils and flours.

As regards other commodities, World Bank analysts predict a mini-rebound in the energy sector, with 9% growth in 2021. Such a recovery, however, would only partially offset losses recorded in 2020, with a price fall of more than 30% that, in the year of lockdowns, mainly affected crude oil per barrel.

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4

Cradle-to-grave environmental profile of organic dry pasta: assessment and mitigation measures

Matteo Cibelli

The assessment of the environmental impact of organic dried pasta is the subject of Mario Cibelli's doctoral thesis. The thesis, briefly summarized in the pages that follow, was awarded one of the Pastaria Awards 2020.

Introduction

The food and beverage industries are seeking to improve their environmental performances. Dried pasta is a food widely consumed throughout the world. The cradle-to-grave carbon footprint (CF_{CG}) of 1 kg of dried pasta ranges between 1.93 and 3.03 kg of carbon dioxide equivalent (CO_{2e}), depending on the type of energy (natural gas or electricity) used in the consumption phase (Barilla 2017). Growing the durum wheat accounts for between 32% and 20% of the CF_{CG}, while cooking accounts for between 31% and 56%, due to the greenhouse gases (GHG) emitted while heating the large volumes of water (10-12 L) used to cook 1 kg of pasta. The environmental performances associated with food and beverage production can be assessed by applying various standard methods (Cimini & Moresi, 2018a). The PAS 2050, Bilan Carbon® and GHG Protocol methods only consider the climate change category (CC), whereas other methodologies – all of which are based on the life cycle assessment (LCA) approach – consider numerous impact categories, estimated in the first phase or at the end of the cause-effect chain. The Life Cycle Assessment (LCA) and Environmental Product Declaration (EPD®), for example, look at 7 midpoint impact categories, while the IMPACT 2002+ method assesses 15 midpoint categories, which are then used to measure the potential damage to Human Health (HH), Ecosystem Quality (EQ) and Consumption of Natural Resources (RD). The Product Environmental Footprint (PEF) methodology, meanwhile, assesses 14 midpoint categories, which are then normalised and weighted to obtain an overall weighted score.

The main objectives of this doctoral thesis were as follows:

- to estimate the cradle-to-grave carbon footprint of 1 kg of organic hulled durum wheat semolina pasta (CF_{CG}), packaged in 0.5 kg polypropylene bags (PP), using the PAS 2050 standard method (BSI, 2008);
- to develop an eco-sustainable cooking system, involving reduced water and energy consumption, which results in cooked pasta that satisfies high chemical, physical and sensory quality standards;
- to describe the environmental profile of organic dried pasta by applying the IMPACT 2002+ standard method (Jolliet *et al.*, 2003) and mitigate its environmental impact.

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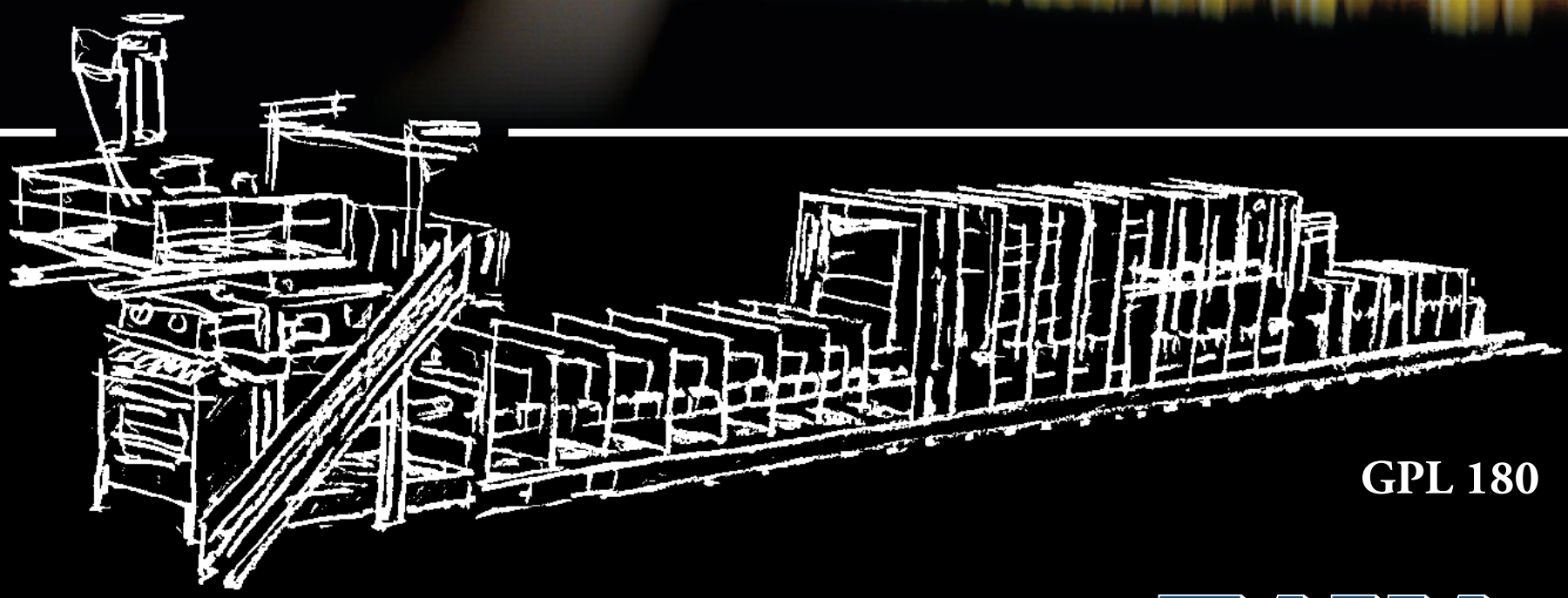

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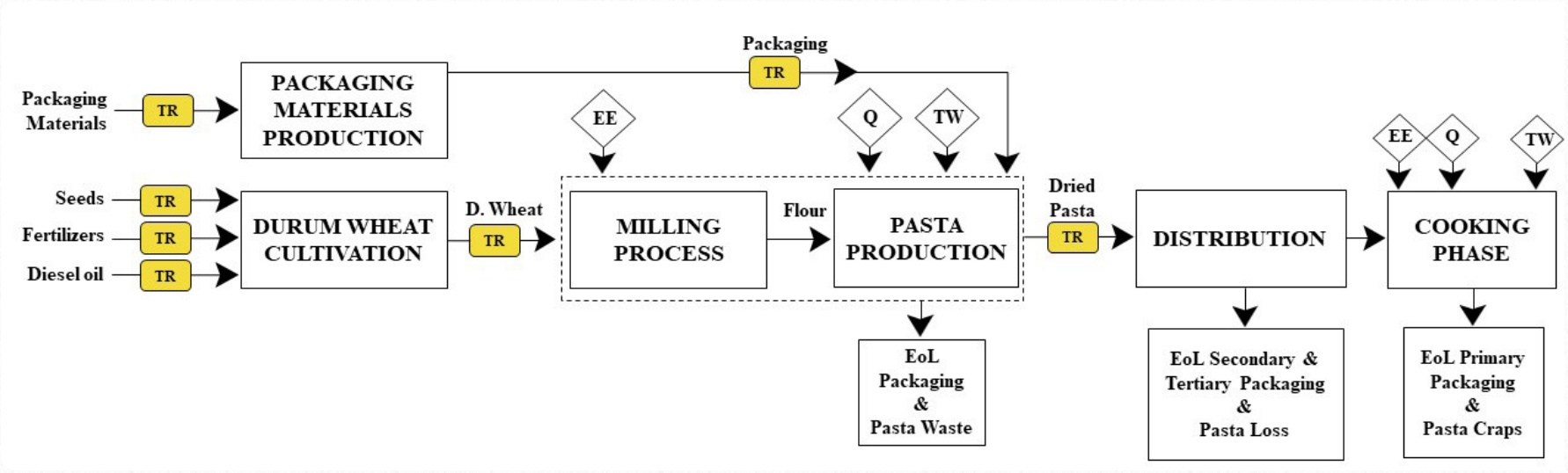
Figure 1 **SYSTEM BOUNDARIES FOR ORGANIC DRIED PASTA: ELECTRIC ENERGY (EE), THERMAL ENERGY (Q), TRANSPORT (TR), WATER CONSUMPTION (TW)**



Materials and methods

Assessment of the environmental impact of dried pasta

The life cycle analysis has been conducted using the standard PAS 2050 (BSI, 2008) and IMPACT 2002+ methodologies (Jolliet *et al.*, 2003). The four stages of the LCA have been carried out as described in ISO 14040 and refer to 1 kg of organic dried pasta packaged in 0.5 kg polypropylene (PP) bags as the functional unit. The pasta was produced between 2016 and 2017 by a medium-sized enterprise located in the south of Italy.

The system boundaries for this study are subdivided into 3 phases (Figure 1). The first phase covers all the processes associated with growing the durum wheat – such as producing organic fertiliser, electric energy and fuel – and with producing the packaging materials. The second phase involves the milling, processing and packaging stages. The third phase covers distribution and use of the product, as well as disposal of the packaging. The primary data were collected directly from the company, while the secondary data were extracted from the SimaPro 9.0.0.41 (Pré Consultants, Amersfoort, NL) software database, as previously described (Cimini *et al.*, 2019d). The CF_{CG} of the functional unit has been estimated by considering the climate change potential over a 100-year time period (IPCC, 1996). The 15 impact categories (IC) considered by the IMPACT 2002+ method have been calculated using their specific characterisation factors (F_{ij}). The impact categories have then been grouped into four damage categories (DC) to highlight the environmental areas subject to the most damage. The effect on human health (HH) has been estimated by considering the impact of carcinogenic and non-carcinogenic substances,

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particulate matter, photochemical smog, ionising radiation and ozone (O_3) depletion, and is expressed in terms of Disability-Adjusted Life Year (DALY), i.e. the years of life lost due to ill health, disability or early death. The impact on ecosystem quality (EQ) arises from the impact of aquatic and terrestrial eco-toxicity, acidification and eutrophication phenomena and land use, and is measured by estimating the potentially disappeared fraction of species (PDF) in the geographical areas affected by pasta production. As the impact of CC on EQ and HH is not sufficiently accurate, climate change (CC) is considered as a standalone damage category and is calculated with reference to a 500-year period, in order to take both short- and long-term effects into consideration (Jolliet *et al.*, 2003). Finally, the environmental impact of the consumption of non-renewable resources (RD) is expressed in terms of the primary energy required to extract an additional unit of minerals and non-renewable primary energy sources. The final assessment is carried out in the normalisation and weighting phases. The respective normalisation factors for HH, EQ, CC and RD are 0.0071 DALY, 13,700 PDF m^2 y, 9,900 kg CO_{2e} and 152,000 MJ per person and per year, and have been obtained by comparing the total of all pollutants, the potentially affected fraction of species, GHG emissions and non-renewable energy consumption in Western Europe to the resident population in that geographical area. A weighting factor of one has been used to aggregate each individual damage category (Jolliet *et al.*, 2003).

Assessment of cooked pasta quality

The analyses below have been carried out using Spaghetti and Penne Rigate, produced by leading Italian pasta making companies. According to the labels, the Penne Rigate and the Spaghetti both had protein content of 135 g kg^{-1} and cooking times of 9 and 10-12 minutes respectively. Their composition has been described by Cimini *et al.* (2019abc), while the pasta cooking system and method, as well as the amount of cooking water and energy used, have been described in Cimini and Moresi (2017) and Cimini *et al.* (2019c). The cooking tests were carried out by varying the water-pasta ratio (WPR) between 2 and 12 L kg^{-1}. To limit sticking while cooking, an S-shaped agitator was used, which rotated at 50 rev min^{-1} for 30 s, stopping for 90, 60 or 30 s respectively for a WPR of 6, 4 or 3 L kg^{-1}. The properties of the cooked pasta were characterised by measuring the water uptake (WU), the

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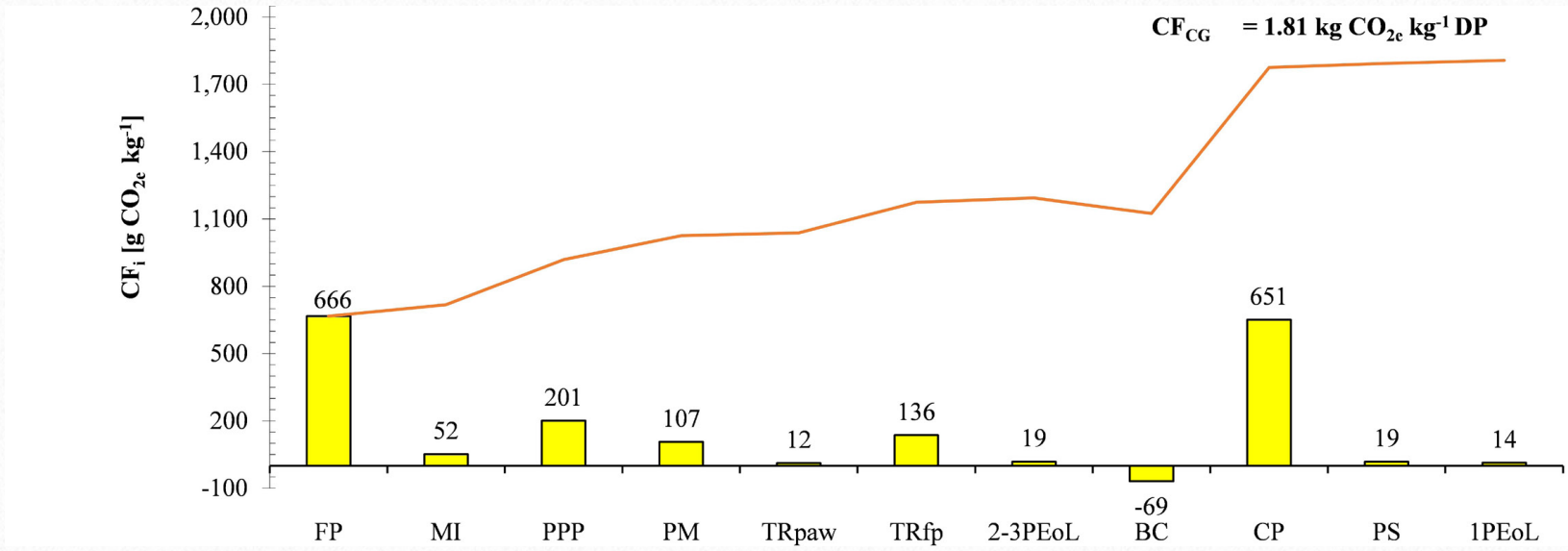
Figure 2 CONTRIBUTION OF THE VARIOUS LIFE CYCLE PHASES TO THE CF_{CG} OF 1 kg OF ORGANIC DRIED PASTA, AS SET OUT IN CIMINI *ET AL.*, (2019D), AND THE CUMULATIVE SCORE (CONTINUOUS LINE)



1PEoL and 2-3PEoL: primary and secondary-tertiary packaging end-of-life
BC: carbon credit from the use of by-products
CP: consumption phase
FP: field phase
MI: milling phase
PM: production of packaging materials
PPP: pasta production and packaging
PS: pasta waste
TR_{fr} and TR_{paw}: transportation of end product, packaging, auxiliaries and waste

cooking loss i.e. the quantity of solids dissolved in the cooking water (CL), the starch gelatinization (SDG), the resistance to deformation measured at 90% (F_{90}) or 98% (F_{98}) using the Universal Testing Machine UTM mod. 3342 (Instron Int. Ltd., High Wycombe, UK) equipped with a 1000 N load cell. Sensory attributes (texture, stickiness and clumping) were also assessed by a panel of six judges (Cimini *et al.*, 2019abc). The carbon footprint of cooking pasta (CF_{PC}) was obtained by multiplying the total electric energy consumed by the corresponding emission factor of 323.6 g CO_{2e} kWh^{-1} (ISPRA, 2018). The innovative eco-sustainable pasta cooking system (EPC) developed here included a commercial induction hob controlled by an Arduino® programmable hardware platform, and digital sensors to control the temperature of the water and to monitor the energy consumed during the cooking process. For more details see Cimini *et al.* (2019f). The data, expressed as averages and standard deviations, were analysed using the Tukey test with a significance level (α) of 0.05.

Results and discussion

The cradle-to-grave carbon footprint of organic dried pasta

As shown in Figure 2, the CF_{CG} of 1 kg of organic dried pasta is approximately 1.8 kg CO_{2e} kg^{-1}, while the contribution of each life cycle phase is expressed in g CO_{2e} kg^{-1}: field phase (666), home cooking (651), pasta production and packaging (201), distribution (148), production of packaging (107), durum wheat milling (52), packaging end-of-life (33) and pasta waste (19). The by-products of the milling phase, as well as the pasta waste generated during the production and packaging phases, have been used as animal feed, resulting in a carbon credit of 69 g CO_{2e} kg^{-1} (Cimini *et al.*, 2019d). The sustainability of dried pasta could be improved by reducing the contribution of the consumption, wheat growing and distribution phases.

Eco-sustainable pasta cooking system

The effect of WPR on the cooking quality of both long and short pasta has been assessed using an induction hob (Cimini *et al.*, 2019abc) and a gas hob (Cimini *et al.*, 2019e). The induction hob was set to the maximum power level (P_H=2 kW) to bring the water to the boil, and then to P_C=0.4 kW for the cooking phase (Cimini & Moresi, 2017; Cimini *et al.*, 2019abc). The main quality parameters for cooked pasta (WU, F_{90}, F_{98}) with regard to both shapes, as well as the energy used to cook the pasta (e_{PA}) and the carbon footprint (CF_{PC}), were analysed and compared to the two levels of WPR as shown in Figure 3.

When WPR was reduced from 10 to 3 L kg^{-1}, WU and CL – the details of which are omitted for the sake of brevity – remained unchanged for the penne rigate, but dropped by approximately 17% for the spaghetti (Figure 3a). On the contrary, the texture of the cooked pasta (F_{90} or F_{98}) was subject to no statistical difference for α=0.05 (Figure 3b). In all tests, the energy efficiency of the induction hob (ηC) remained constant (67±3%), while both e_{PA} and CG_{PC} decreased respectively from 1.55±0.04 to 0.55±0.01 Wh g^{-1} (Figure 3c), and from 0.55 to 0.19 kg CO_{2e} kg^{-1} (Figure 3d). For WPR=3 L kg^{-1}, the energy consumed to stir the pasta and avoid it sticking was ~0.0011 Wh g^{-1}, and therefore entirely negligible compared to the e_{PA}. As such, compared to cooking 1 kg of dried pasta in 10 L of water – as is commonly recommended by pasta-makers – the cooking procedure verified here, with WPR=3 L kg^{-1}, would result in a significant reduction in GHG emissions

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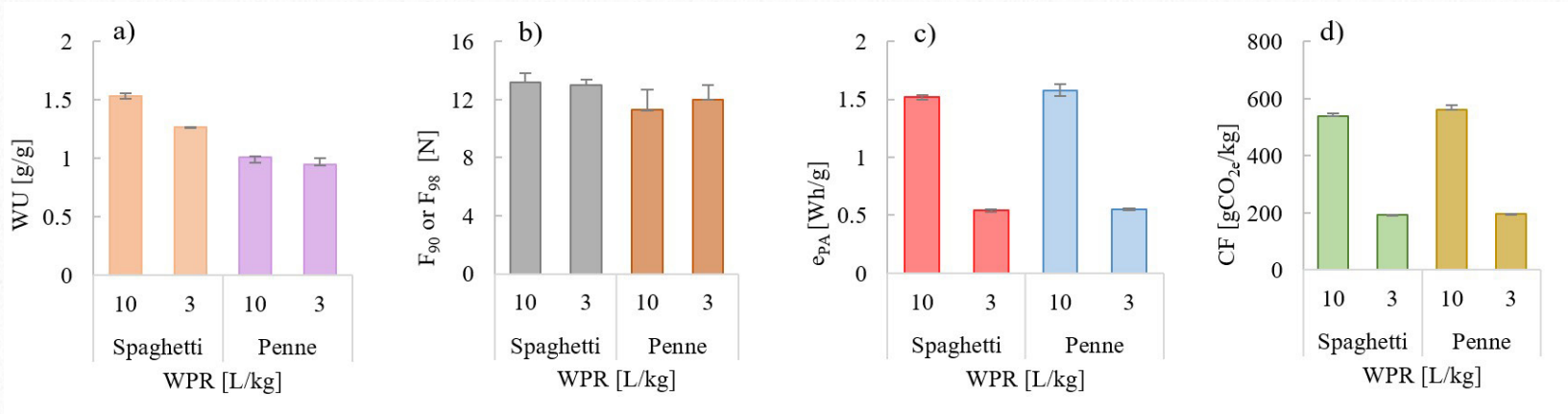
Figure 3 FFECT OF WPR ON A) RELATIVE WATER INCREASE (WU); B) TEXTURE AT 90% OR 98% DEFORMATION (F_{90} OR F_{98}); C) SPECIFIC ENERGY CONSUMPTION (E_{PA}); D) CARBON FOOTPRINT (CF_{PC}) FOR BOTH PASTA SHAPES



associated with current Italian consumption (~1.61x10^6 Mg yr^{-1}) of dried pasta.

Environmental profile of organic dried pasta

The cradle-to-grave environmental profile of 1 kg of dried pasta according to the IMPACT 2002$^+$ V2.14 method is illustrated in Table 1. The impact of the field phase takes account of the contribution of a large number of impact categories (IC), specifically, in increasing order: non-carcinogenic substances, photochemical smog, ionising radiation, particulate matter, aquatic acidification, terrestrial acidification/eutrophication and land use. The impact of the consumption phase relates to climate change, non-renewable energies and mineral extraction. Even when calculated over a 500-year period, climate change remained dominant in the consumption phase. The 15 impact categories in Table 1 are grouped into 4 damage categories (DC), to highlight the areas of the environment damaged by the life cycle of dried pasta. As indicated by the underlined and italicised characters in Table 2, the damage to HH and EQ mainly related to the field phase, while CC and RD damage is predominantly associated with the consumption phase. Table 2 also shows the overall weighted score (OWS) for damage. EQ was the damage category most affected (45.6% of the OWS), followed by RD (20.5%), CC (19.9%) and finally HH (14.2%). The life cycle phase that most contributed to the overall weighted damage (825 µpt) was growing (63%), followed by cooking (19%), milling the wheat and producing the pasta (9.5%), transport (6.2%) and packaging production (4.0%). The packaging end-of-life phase had a negative impact on the OWDS (-1.5%).

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Table 1 ENVIRONMENTAL PROFILE FOR 1 kg OF ORGANIC DRIED PASTA ACCORDING TO THE IMPACT 2002+ METHOD, PERCENTAGE CONTRIBUTION OF THE VARIOUS LIFE CYCLE PHASES (SEE SYMBOLS IN FIGURE 2) AND SCORE FOR EACH INDIVIDUAL IMPACT CATEGORY (IC_J)

Impact Categories (IC_j)	Contribution of the Life Cycle phases (%)					IC_j Score	Unit
	FP	MI+PPP	PM	TR	CP		
Carcinogens	8.8	46.3	*35.5*	1.7	7.8	$1.02x10^{-2}$	kg $C_2H_3Cl_e$
Non-carcinogens	40.5	16.7	15	19.6	8.2	$1.11\ x10^{-2}$	kg $C_2H_3Cl_e$
Particulate matter	76.1	7.4	3.1	4.2	*9.2*	$1.85\ x10^{-3}$	kg $PM_{2.5}e$
Photochemical smog	47.8	13.3	10.9	6.4	*21.6*	$3.16\ x10^{-4}$	kg C_2H_{4e}
Ionising radiation	63.8	11.4	3.9	7.5	*13.3*	9.34	Bq $^{14}C_e$
Ozone depletion	36.2	*24.3*	5.8	16.4	17.2	$1.23\ x10^{-7}$	kg CFC-11_e
Aquatic eco-toxicity	*23*	14.3	36.7	14.5	11.5	58.4	kg TEG water
Terrestrial eco-toxicity	*25.2*	15.7	17.8	36	*5.3*	28.1	kg TEG soil
Terrestrial Acidification/ Eutrophication	91	3	1	1.1	*3.9*	0.154	kg SO_{2e}
Aquatic Acidification	85.6	4.7	1.7	1.5	*6.5*	$2.1\ x10^{-2}$	kg SO_{2e}
Aquatic Eutrophication	43.8	14.5	11.6	7	*23.1*	$1.13\ x10^{-4}$	kg PO_4^{3-}
Land Use	99.6	0	*0.3*	0	0.1	3.8	m^2 org. arable
Climate change	*28.5*	16.1	6.3	7.5	41.5	1.45	kg CO_{2e}
Non-renewable Energies	*28.2*	16.4	6.9	6.9	41.7	24.3	MJ primary
Extraction of minerals	*38.3*	0.8	4.6	0.3	56	0.003	MJ surplus

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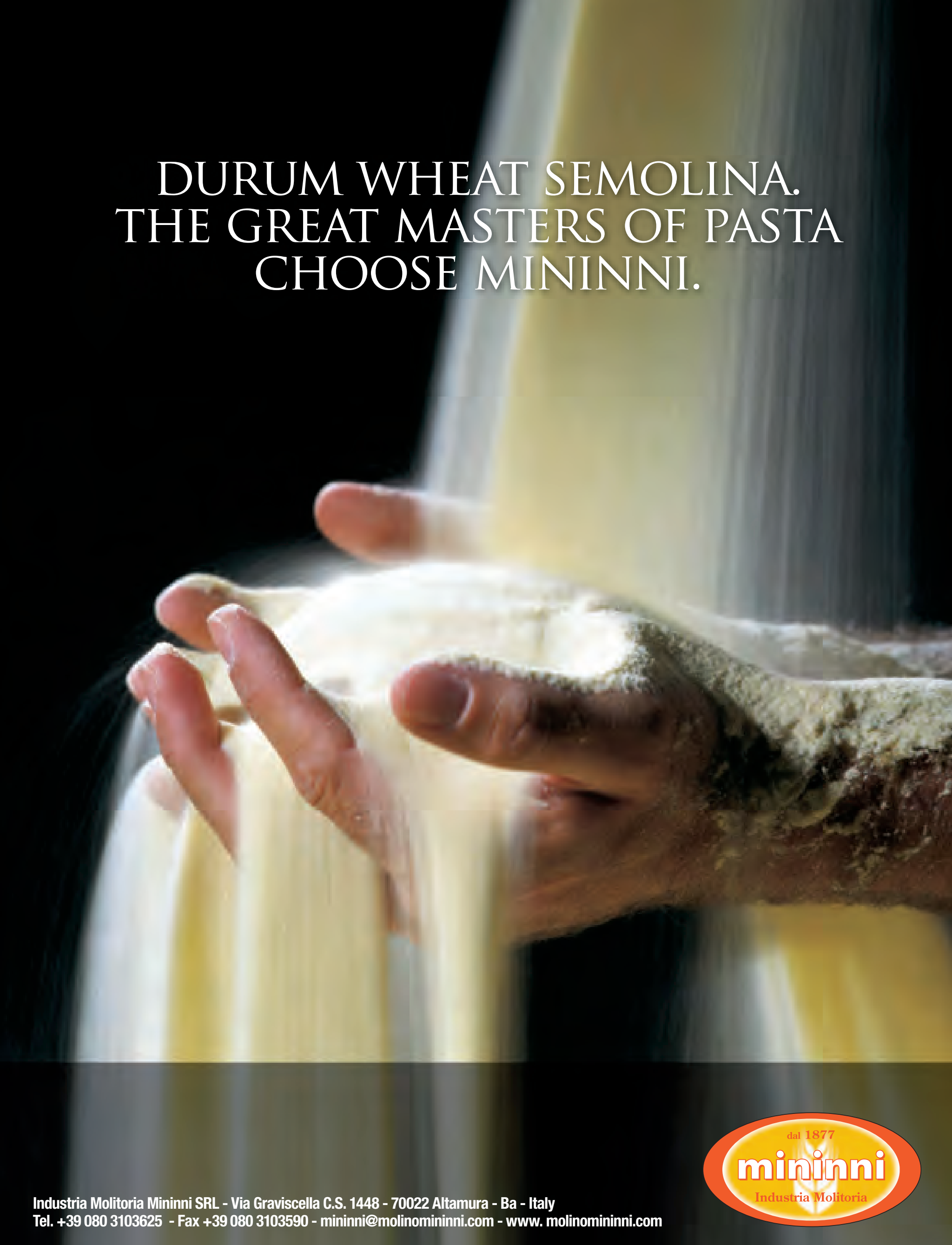
Tabella 1 ASSESSMENT OF DAMAGE, ACCORDING TO THE IMPACT 2002+ METHOD, ASSOCIATED WITH THE PRODUCTION OF 1 kg OF ORGANIC DRIED PASTA PACKAGED IN 0.5 kg PP BAGS: PERCENTAGE CONTRIBUTION OF THE VARIOUS LIFE CYCLE PHASES (SYMBOLS AS IN FIGURE 2), INDIVIDUAL SCORES (SS_J) AND WEIGHTED SCORES (WS_J) OF EACH DAMAGE CATEGORY (DC_J) AND OVERALL WEIGHTED DAMAGE SCORE (OWDS)

Damage Categories (DC_j)	Contribution of the Life Cycle phases (%)						SS_j	Unit	WS_j (µpt)
	FP	MI+PPP	PM	TR	CP	EoLPM			
Human Health (HH)	49.2	18.3	6.6	12.1	*19*	-5.3	$8.28x10^{-7}$	DALY	117
Ecosystem Quality (EQ)	94.6	1	2.08	*2.09*	0.8	-0.6	5.15	PDF m^2 yr	376
Climate Change (CC)	*35*	15.3	3.7	8.4	37.8	-0.2	1.62	kg CO_{2e}	164
Resource Consumption (RD)	*30.1*	16.7	6.5	8.9	40.1	-2.3	25.7	MJ primary	169
Overall Weighted Score (OWS)	63.1	9.5	4	6.2	*18.8*	-1.5			**825**

Mitigation options

Any mitigation action must first focus, on an a priori basis, on reducing damage in terms of EQ, and then in terms of CC and RD. Numerous studies have shown that organic durum wheat farming in Italy is an activity characterised by low GHG emissions per hectare, which, when considered in light of the lower yields per hectare, are found to be higher than those typical of conventional farming. Considering the yield per ha and land use in the tests carried out in southern Italy by Ruini *et al.* (2013) and Fagnano *et al.* (2012), where crop rotation methods were applied, it was found that the growing conditions considered here led to higher yields of durum wheat (3,75±0.27 Mg ha^{-1}) and land use (0.7 ha $year^{-1}$). As such, no mitigation action has been considered with regard to the growing method. The eco-sustainable cooking procedure (EPC) controlled via the Arduino® microprocessor, using a water-pasta ratio of 3±1 L kg^{-1}, resulted in overall energy consumption of 0.6±0.1 kWh kg^{-1} and, as such, was potentially capable of reducing the environmental impact of the pasta cooking phase. In this case, GHG emissions associated with the various phases of the life cycle did not change, with the exception of the cooking phase, which



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saw a reduction to 0.27 kg of CO_{2e} kg^{-1}. Overall, the CF_{CG} was reduced to 1.6±0.2 kg CO_{2e} kg^{-1}, approximately 19% lower than the reference case (RC). Using the EPC reduced the score of each RD and CC damage category by 22%, while damage to EQ remained unchanged, and damage to HH increased slightly by 6%. The overall weighted damage score decreased by approximately 8% (764±22 µpt).

Conclusions

The field-to-table carbon footprint (CF_{CG}) of 1 kg of organic hulled durum wheat semolina dried pasta is mainly influenced by the field phase and the consumption phase. Since the energy requirements associated with cooking accounted for a significant portion of the energy consumed throughout the product life cycle, an eco-sustainable cooker was developed to limit energy and water consumption. The environmental profile of dried pasta was assessed using the IMPACT 2002+ methodology, and it was found that the category involving the most damage was ecosystem quality, which, in turn, was strongly influenced by the land use category. The use of the eco-sustainable cooker developed here made it possible to decrease CF_{CG} and OWS by 19% and 8% respectively.

Given that defining the environmental profile of each individual product is certainly costly, and the impact category relating to climate change is by far the most reliable (Wolf *et al.*, 2012), the carbon footprint estimate would seem to be the most cost-effective tool to identify the phases of the life cycle of a product that have the greatest impacts, and it is probably the best method to begin to improve the sustainability of 99% of small- and medium-sized food enterprises.

To reduce energy consumption and improve the environmental performance of dried pasta, future research should first of all explore the potentials of organic farming with a view to achieving a net increase in yields per ha and, secondly, encourage pasta makers to develop new products, e.g. pregelatinized options, which have a lower impact in the consumption phase. Finally, it seems the time has also come for pasta makers not only to make pasta-based products, but also to develop more appropriate cooking systems, to enable amateur cooks to cook pasta more simply, consistently and quickly with a very low environmental impact.

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5

Italian pasta, final export figures for 2020 could reach € 3 billion

Pastaria Centre for Economic Research

Almost 2 million tons of Italian pasta exported out of the Peninsula in the first nine months of 2020, approximately 17% more than in the same period of the previous year.

Production, orders and turnover all performing strongly. A very positive performance for Italian pastas, which benefited from a similar bumper demand from abroad as experienced on the domestic market.
The panic buying associated with the health crisis and lockdowns – resulting in a strong boost for pantry food product sales – has led to exports of nearly 2 million tonnes of Italian pasta in the first nine months of 2020, an increase of approximately 17% compared to the first three quarters of 2019.
The year-to-date figures as at 30 September point to an even stronger performance if analysed in terms of turnover, with revenue of nearly € 2.3 billion, representing year-on-year growth of over 17%.
Such effects of changes in purchasing habits, brought about by the COVID-19 pandemic, were to bound to be seen abroad, too, with one in four plates of pasta eaten internationally coming from Italy.
Furthermore, Italy remains the world's leading producer of pasta – by a significant margin – ahead of the United States and Turkey. Despite its dependence on foreign supplies of grain – with national production falling short by about 30-40% in relation to the annual demand in the milling and pasta industry – Italy's status as the great processor of food ingredients gives the country a "structural" competitive and reputational advantage abroad, primarily thanks to the success of key products such as pasta.
The entire supply chain has shown a great capacity to react and adapt to the new situation. It has withstood the impact of COVID-19, strengthening logistics and production and responding to an unexpected surge in demand.
As well as an increase in orders from buyers at domestic large-scale retail organisations, sector operators also faced a sudden increase in demand from abroad, and particularly from Germany, the United Kingdom, USA and Japan. These established markets saw strong growth in the sale of Italian pastas in this period, with double-figure increases seen across almost all main markets, with the sole exception of Spain.
A geographical analysis of the destinations, based on ISTAT figures, confirms these results, with increases of almost 40% in physical exports to the USA, and orders up 17% in Germany and 24% in the United Kingdom. Performance on the French market was more modest, but still solid, with a 7% increase in the quantities exported to the country. The situation was better in Japan, with orders

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Table 1 ITALIAN PASTA EXPORTS

	Tonnes			€ ,000		
	Jan-Sep 2019	**Jan-Sep 2020**	**Variation**	**Jan-Sep 2019**	**Jan-Sep 2020**	**Variation**
World	1,649,039	1,921,988	16.6%	1,951,415	2,285,835	17.1%
EU-28	1,067,639	1,204,099	12.8%	1,269,460	1,410,749	11.1%
Non-EU	581,400	717,889	23.5%	681,955	875,086	28.3%
United States	165,895	229,636	38.4%	253,887	353,716	39.3%
Germany	287,655	335,724	16.7%	297,487	350,267	17.7%
United Kingdom	216,730	268,518	23.9%	245,139	300,904	22.7%
France	200,339	214,764	7.2%	273,234	288,069	5.4%
Spain	50,035	48,131	-3.8%	89,330	85,449	-4.3%
Japan	58,612	69,606	18.8%	56,800	68,830	21.2%
Belgium	47,654	49,310	3.5%	59,950	61,138	2%
Sweden	44,280	47,627	7.6%	55,483	57,992	4.5%
Switzerland	27,717	33,919	22.4%	43,238	53,797	24.4%
The Netherlands	42,846	44,453	3.7%	49,014	52,691	7.5%
Australia	25,013	36,603	46.3%	34,717	49,151	41.6%
Canada	22,053	28,746	30.3%	33,318	43,324	30%
Austria	27,107	30,462	12.4%	31,638	36,171	14.3%
Poland	24,432	23,917	-2.1%	25,508	26,112	2.4%
Saudi Arabia	20,767	33,925	63.4%	17,238	25,294	46.7%
Denmark	16,278	17,547	7.8%	20,378	22,941	12.6%
China	23,962	27,783	15.9%	18,103	22,702	25.4%
Israel	20,317	24,933	22.7%	16,594	20,738	25%
Russia	20,627	20,403	-1.1%	19,556	20,589	5.3%
Brazil	18,057	17,071	-5.5%	19,161	20,074	4.8%
Czech Republic	18,554	18,290	-1.4%	16,836	16,947	0.7%

Source: Pastaria elaboration of ISTAT (Italian State Statistics Institute) data

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from the country up 20%, and better still in Switzerland (+22%), Canada (+30%) and Australia (+46%).
Also worth noting is Saudi Arabia, where sales were up 60% compared to the first nine months of 2019, albeit in the context of significantly smaller volumes (+16% in China).
Exports to Russia slowed, meanwhile, with the currency and political situation negatively affecting imports from abroad, in general, something that is also impacting other food sectors. Government sources have signalled plans to increase self-sufficiency in the durum wheat supply chain. Estimates by the Ministry of Agriculture in Moscow suggest that greater investment and heavy use of new technologies will allow Russia to double its production of wheat, used to produce pasta and couscous, to 1.8 million tonnes by 2025. This effort is already under way, in a drive to stabilise food prices, in light of recent criticism levelled by Vladimir Putin at pasta exporters, deemed partly responsible for the increase in prices.
Returning to Italian exports, an analysis of monthly data provides a clearer picture of the impact of the crisis on purchasing trends. The two-month period of March and April, for instance, which coincides with the first lockdown, saw a year-on-year increase in overseas sales of Italian pastas (in terms of value, compared to the same months in 2019) of 37% in March and 35% in April. Over the course of just thirty days between February and March, meanwhile, an increase in exports of almost 30% was recorded.
Annual trends slowed in the May-July quarter, despite remaining strong, in the double digits, while the monthly export trends for the same period dipped into negative territory. It should be noted that the latest figures, concerning the month of September, show a return to double-digit rates in terms of both annual and monthly trends. Specifically, ISTAT data reveals growth of 11.4% compared to September 2019, and a major rebound of 17% compared to the month of August.
Supposing that export values in the fourth quarter of 2020 remain consistent with the previous year, the 12-month period is expected to close with growth of 13% in terms of turnover, projected to reach a record € 3 billion.
Finally, it should be noted that records for the first three quarters of the year just ended do not reveal particular price tensions. The average export value of Italian pasta was € 1.19/kg, compared to an average of € 1.18/kg for the same period in 2019.

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6

The Italian Budget Law establishes a register for monitoring cereals

Editorial staff

The aim is to track all movements of both national and foreign products. Italmopa: a useless and costly burden on businesses; similar requirements are already contained in food industry traceability regulations and tax regulations concerning warehouse records.

Among the many new tax, labour and finance measures introduced by the Italian Budget Law 2021 (law no. 178/2020), published in Ordinary Supplement no. 46/L to the Official Gazette of 31 December 2020, is paragraph 139 of article 1, establishing the “Granaio Italia” (Italian Grain Register).

In accordance with the measure introduced by way of an amendment by the Five Star Movement, any entity that holds cereals and cereal flours, in any capacity, will be required to record all loading and unloading operations in a dedicated electronic register, set up as part of the Italian National Agriculture Information System (Sistema informativo agricolo nazionale – SIAN), if the quantity of the individual product exceeds five tonnes per year.

The law states that its aim is to enable accurate monitoring of production activities involving cereals at a national level, including with a view to achieving the aims of article 39 of the Treaty on the Functioning of the European Union concerning the objectives of the common agricultural policy.

The following paragraph (140) states that loading and unloading operations for the sale or processing of cereals and cereal-based flours, originating within the country or union, or imported from third countries, must be recorded within seven working days of such operations.

The Ministry of Agriculture, Food and Forestry Policies (MIPAAF) will be responsible for setting out the methods for implementing the creation and operation of the Register, in a decree to be issued within sixty days of the date of entry into force of the law (and so by the beginning of March, ed.). A sum of € 1 million has been allocated to launching the project as part of the 2021 budget (par. 141).

As regards penalties (par. 142), the law states that failure by any person obliged to enter information in the Register to fulfil that obligation will result in a fine of between € 5,000 and € 20,000. Again in relation to penalties, the paragraph also provides for a fine of between € 1,000 and € 5,000 for persons who fail to comply with the electronic methods associated with the Register, as set out in the implementing decree issued by MIPAAF.

It should also be noted that breaches (failure to record operations) involving quantities of cereals or cereal flours in excess of 50 tonnes will be subject to an additional sanction consisting of the closure of the relevant premises for between seven and thirty days. The authority responsible for imposing the penalties is the MIPAAF General Inspectorate for Quality Control and Fraud

Prevention, which also oversees compliance with relevant legislation.
Luciano Cillis (M5S), the first person to sign the amendment, stated that “the measure establishing the ‘Granaio Italia’ brings the cereal industry up to the same level as the oil and wine industries: indeed, the aim is to track the movement of all categories of cereal in Italy at each various stage, for both domestic and imported products. The goal – the parliamentarian added – is to give certainty to consumers, improving their knowledge of 100% Italian products such as pasta, bread, bakery products and flours”.
Italmopa, the Association of Italian Millers, a member of Federalimentare/Confindustria, views the approved amendment to the 2021 Budget Law as placing an additional significant and unjustified administrative and financial burden on companies operating in the national milling sector.
Its chairman, Cosimo De Sortis, has referred to the measure as “aberrant, incomprehensible, adopted without any consultation with the industries involved, and in stark contrast with the recognised need for greater simplification, which penalises the primary processing industry in particular, placing a new, double burden on its operators, without any concrete benefit whatsoever to consumers”.
De Sortis notes that “the information to be used by the Electronic Register is already mandatory, as it is required by food industry traceability regulations and tax regulations concerning warehouse records”.
As well as being useless, the provisions also appear to be strongly discriminatory – Italmopa observes – on a sector level, given that the scope of application is limited to the cereal sector, and on an international level, given that no other EU or non-EU country is currently subject to such regulations.
The Association notes that national cereal production is clearly structurally unable to meet the demands of the industrial processing sector.
On average, imported durum wheat (the majority of which comes from Canada) accounts for approximately 35% of the annual quantities processed by the milling industry to produce semolina, the largest share of which is used by pasta factories.
In terms of soft wheat, imports are used to cover nearly two-thirds of demand, with domestic production only capable of meeting approximately 35-40% of that demand.

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7

The Argentinian pasta industry in UIFRA's 2020 Yearbook

UIFRA

The Pasta-Making Companies Association of the Argentine Republic (UIFRA) has recently released the 2020 edition of its Yearbook which takes stock of the activities and trends in the South American country's pasta industry.

Argentine creative artists have been using pasta “nests” as a metaphor to describe an “entangled” year. Naturally, the consequences of the pandemic have permeated the 2020 yearbook, but the publication does not focus solely on COVID-19.

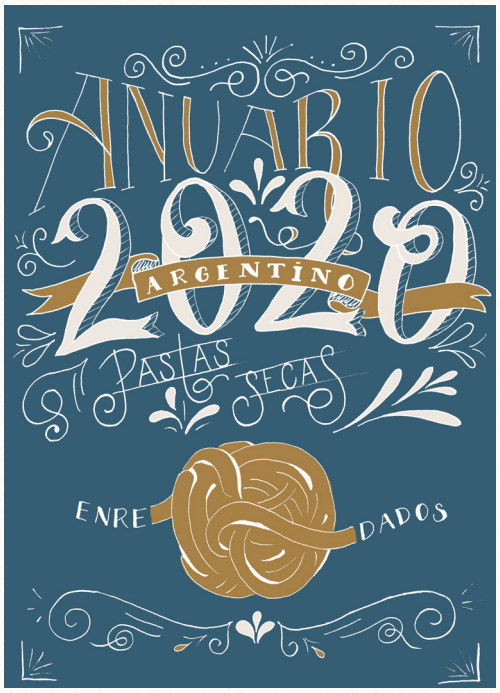
Government measures

For dry pasta companies, 2020 was crisscrossed by a series of strong regulatory initiatives issued by the government, which even now have a crucial effect on the pasta industry. The most important of these concerns the price freeze in a scenario marked by high inflation.

Argentina will end 2020 with inflation standing at around 36%. However, in dealing with the pandemic, the Argentine government decided to freeze the prices of all products of mass consumption and manufacturers had to take their prices back down to those registered on 6 March.

Another important issue was the enactment of the so-called “Gondola Law”, which establishes a minimum of 5 suppliers per product category and states that none of them shall exceed 30% of retail shelf space.

Download the UIFRA Yearbook



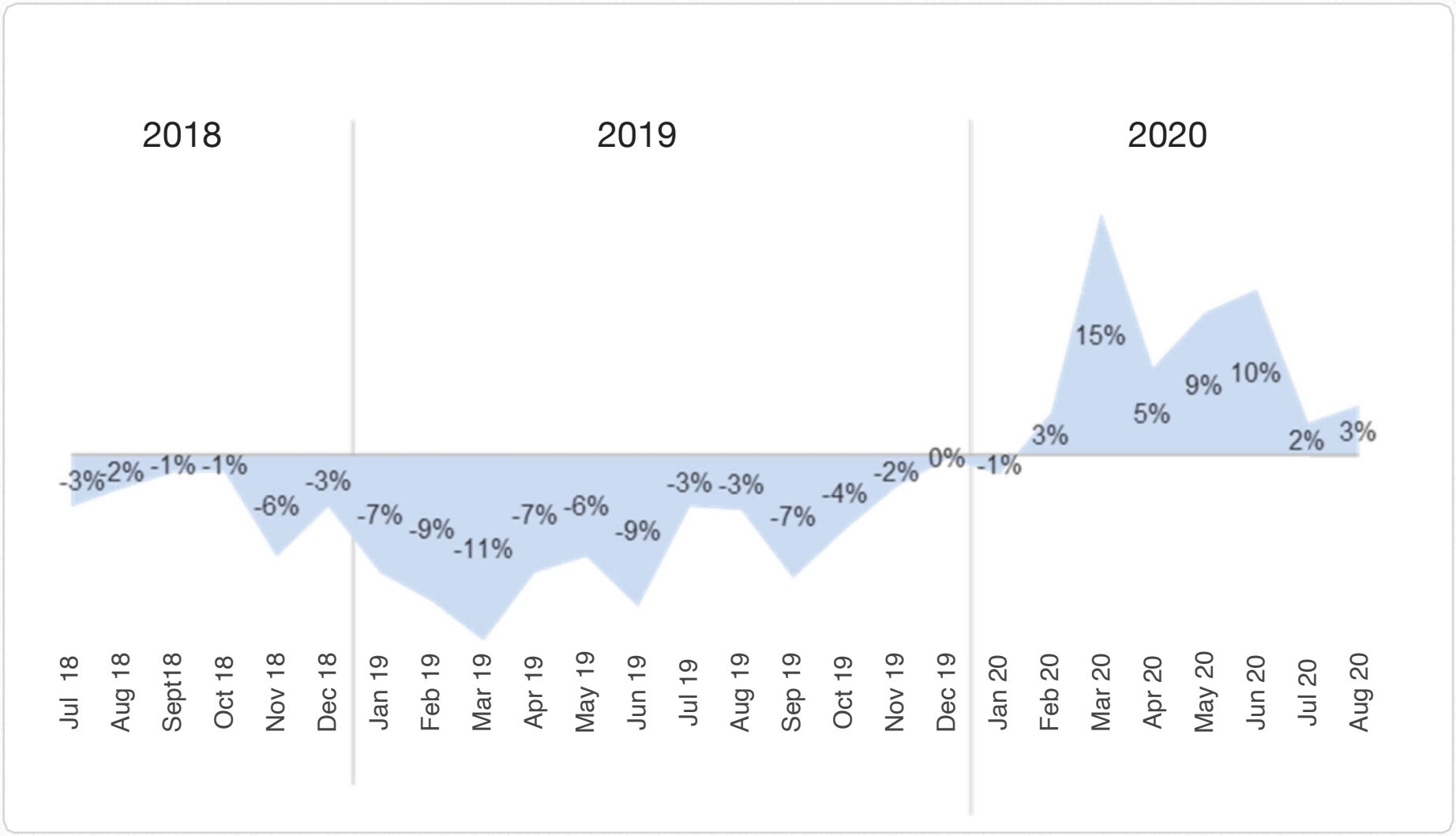
Domestic market

The situation in Argentina has not been different to that experienced in other countries. Since early March, supermarkets have experienced mass buying, however, no shortages occurred.

Dry pasta demand remained high, mostly during March and April. Then, it tended to stabilize but with low prices and a focus on the cheapest varieties.

Another aspect worth mentioning is the State’s food assistance program. During the pandemic, the Argentine Ministry of Social Development invested over USD 1000

Chart 1 FOOD, BEVERAGES, CLEANING AND PERSONAL CARE BASKET. % VARIATION IN VOLUME



million in food.
Consequently, factories listed as State suppliers have been working at a rate of knots, while others have been experiencing a decline in sales since August.

A glance at Latin America

With articles on Peru and the South of Brazil, the 2020 Yearbook seeks to deepen the understanding of the dry pasta market in the rest of Latin American. Peru's experience in the development of Andean crops is really important and Argentina should reap the best of it.
In addition to many other crops, Argentina is capable of producing quinoa and amaranth in large geographic areas. This places the country in a position of being able to introduce significant innovation into the food industry regarding the manufacture of pasta using these non-traditional raw materials.
Although UIFRA's 2020 Yearbook is written in Spanish, the main articles have been translated into English. You can download a copy of the yearbook here:
https://anuario.uifra.org.ar/

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8

Gluten proteins: molecular fingerprinting for the quality and traceability of Sicilian local durum wheat varieties

Giovanna Visioli[1], Alfio Spina[2], Gabriella Pasini[3]

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Here is a brief summary of the contribution of Giovanna Visioli and Alfio Spina at the conference *From the field to the table: state of the art of research applied to pasta*, held at the 2020 edition of the Pastaria Festival.

Recently, there has been a “retrieval” of knowledge and ancient traditions which have increased consumer demand for “local varieties” of wheat; a demand which is almost reaching the proportions of a business boom. In reality, this new trend has not taken the Italian agricultural sector by surprise, since a number of “local varieties” have always been cultivated, but in the past their production was considerably limited due to their low yield, their tendency to lodge and their rheological properties, which were not the best for producing high performance results in terms of bread-making and pasta-making.

Numerous scientific research studies have highlighted their nutritional and nutraceutical characteristics, in terms of mineral content (Ficco *et al.*, 2009) and polyphenols (Dinelli et al 2011), higher compared to the modern varieties on the market, and also their lower gluten index (Fiore *et al.*, 2019). Despite this, some native varieties have proven to be technologically sustainable, such as for example the variety known as *Cappelli* (Figure 1), for the production of pasta (Acquistucci *et al.*, 2020) or bread (Comendador *et al.*, 2010) and the *Ruscìa*, better known as *Russello* ibleo, for the production of “Ibleo durum wheat bread” (Ragusa and Siracusa), *Timilia*, in percentages of 30%, for the production of “Castelvetrano black bread” (Trapani) (Spina *et al.*, 2006) , which is a Slow Food presidium, *Timilia* and *Russello* (*Priziusa*) for the production of “Monreale bread” (Palermo) (Melini *et al.*, 2020).

In addition, the more strenuous resistance against weeds demonstrated by these genotypes, thanks to their high stature, makes them ideal for cultivating in organic farming.

In Sicily, many “local” and “ancient” varieties, mainly of durum wheat, cultivated organically, are repopulating the cereal-growing areas of the countryside, thanks to their ability to adapt to the island’s different soil and climate conditions, their ruggedness and resistance to biotic and abiotic stress.

The Centre of Research for Cereals and Industrial Crops of Acireale (Catania), together with the other public – and also private – research agencies, contribute to the fundamental work of conservation,

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maintenance, multiplication and distribution of the germplasm of these wheat varieties, thereby promoting the biodiversity of Sicily's agri-cultural heritage.
Since 2009, the Ministry of Agricultural, Food and Forestry Policies and Tourism has kept a specific National Register of native varieties, and of varieties that have adapted naturally to local conditions and are threatened by genetic erosion (Legislative Decree no. 149 of 29/10/2009). Inclusion in the Register means that certified seed can be produced and this should make it possible to protect the farmer, on the one hand, in terms of the quality of grains that he markets, and the final consumer on the other, creating a supply chain with backward and forward traceability, thereby creating the basis for guaranteeing the identity of the finished product. To date, however, it is not possible to provide a consumer guarantee for the purchase of processed monovarietal products, not only because a certification system of the processed product has not yet been developed, but also because a seed traceability and certification system has not been sufficiently implemented.
On the other hand, consumers of "local variety" products need guarantees on the identity of the product they are consuming. So, if the wheat farmer has used certified seed of a specific local variety, the whole grain he will obtain can be milled and processed into primary (semolina/flour/whole wheat flour) or secondary (pasta, bread, etc.) processing products that can be labelled as monovarietal.
Therefore, in order to increase the supply and promote these products, some Sicilian companies have launched "local varieties" of flours and by-products (especially pasta) on the market, *Timilia*, *Russello*, *Perciasacchi* and *Maiorca* and ancient varieties such as *Margherito* and *Cappelli*, which are duly recorded in the National Register (Figure 1, Figure 2).
However, the exchanging of seeds between farmers can lead to genetic pollution of the genotype during the sowing phase and, above all, during the harvest, since residues of other seeds remain among the moving parts of the agricultural machinery.
For this reason, the identification of markers for quality, backward and forward traceability of "local varieties" and their respective processed products becomes necessary, in order to maintain this precious supply chain.
Help in this regard can be provided by an analysis of the gluten proteins. Gluten is a protein complex, typical of almost all

Figure 1 ***CAPPELLI*** **VARIETY RIPENING IN FIUMEFREDDO DI SICILIA (CATANIA, ITALY)**

small-grain cereals, consisting of hundreds of protein components structured in the form of monomers and polymers. In general, gluten proteins are divided into alcohol-insoluble polymeric glutenins and alcohol-soluble monomeric gliadins and their interactions are fundamental in determining the quality of the by-products, e.g. the behaviour of dough during cooking or the rising of the bread and other leavened bakery products.
High molecular weight glutenin subunits (HMW-GS), which are characterised by having a lower number of protein alleles compared to the other gluten fractions, can act as both as quality markers, already used in breeding programmes to select cultivars with the desired technological characteristics, and in order to verify the purity of the seed and, consequently, of the flours that are labelled as monovarietal and sold on the market.
On the basis of these assumptions, researchers extracted and characterised the HMW-GS of pure seeds of *Timilia* (syn. *Tumminia*), *Russello* (syn. *Priziusa*), *Perciasacchi* (syn. *Strazzavisazzi*), *Margherito* (syn. *Bidì*) (durum wheats) and *Maiorca* (soft) using techniques such as protein electrophoresis and mass





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Figure 2 SICILIAN "LOCAL" AND "ANCIENT" VARIETIES OF DURUM AND SOFT WHEAT

spectrometry (Visioli *et al.*, 2016) in order to be able to use them as purity markers for the batches of whole grains and flours obtained by a Sicilian farm business in the Ragusa area.

The results of the analyses highlighted the presence of different protein structures within the individual batches of whole grains, which are reflected in the corresponding flours labelled as monovarietal. In particular, *Timilia* and *Russello* account for 70% of the corresponding batch; the latter makes up 70% of the whole grains of the batch defined *Russello*, which consists of 50% *Russello* and 20% *Ruscìa* (syn. *Russello ibleo*); the *Margherito* batch contains 47% of *Margherito* whole grains and 40% of *Timilia*, while the *Perciasacchi* batch only presents 13% of *Perciasacchi* seed and 74% of seed with the *Timilia* profile.

HMW-GS structures of soft wheat of the

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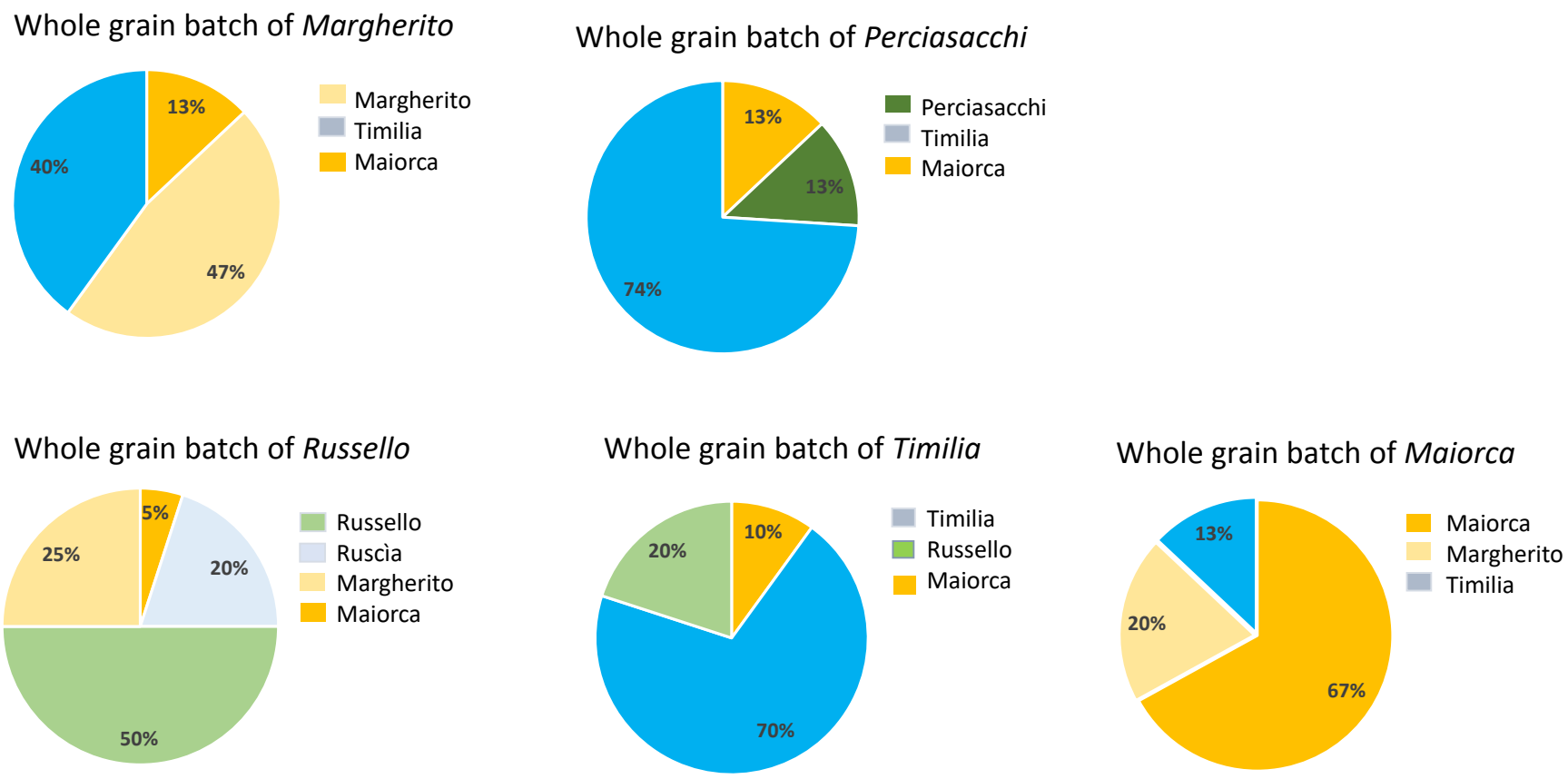
Chart 1 DIFFERENT PERCENTAGES OF SICILIAN “LOCAL” AND “ANCIENT” VARIETIES OF DURUM AND SOFT WHEATFOUND IN WHOLE GRAIN BATCHES LABELLED MONOVARIETAL



Maiorca variety are present in these 4 batches as well. Also the wheat labelled *Maiorca* is represented at 67% while the remainder presents durum wheat contamination (Chart 1).

In any case, the contamination found in all the samples analysed is internal to the company and the samples are cross-contaminated without the presence of other varieties. Therefore, contamination may be due to the mixing of seeds during harvesting with mechanical machinery, during the storage of the grain, or – to a much lesser extent – to possible cross-pollination between different genotypes. So in order to obtain monovarietal semolina, and hence monovarietal pasta or bread, scrupulous controls must be carried out in the field, with careful purging and thorough cleaning of the internal working parts of the combine harvester.

In conclusion, the products obtained from flour of “local varieties” of wheat enrich the Sicilian agri-food sector, and this is an aspect of increasing interest to consumers. Researchers are also involved in study paths and promotion initiatives, the aim of which is to highlight the many plus points of these varieties, not only in nutritional and nutraceutical terms but also from a cultural, ethical, environmental and

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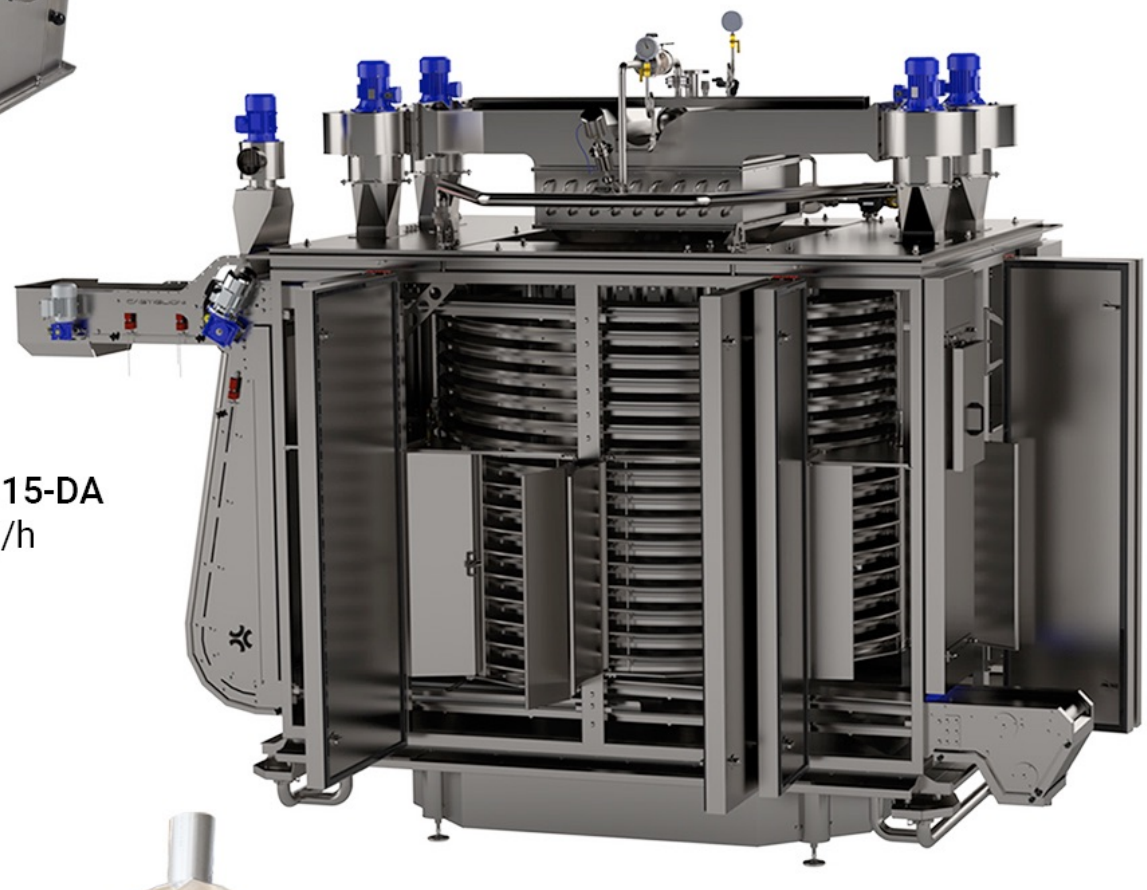

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economic perspective. Although constantly growing, the Sicilian so-called “ancient grains” supply chain is still structurally weak and requires close attention and guidance in consolidating its organisation, in view of the introduction of regulations in the production of the seed and the implementation of backward and forward traceability systems which are, to date, still inadequate.

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9

Mould on pasta: a matter of air quality

Luca Sivelli
Bakery and Pasta Consulting

The use of ozone in pasta production environments can be extraordinarily effective in sanitizing the air and reducing the risk of mould.

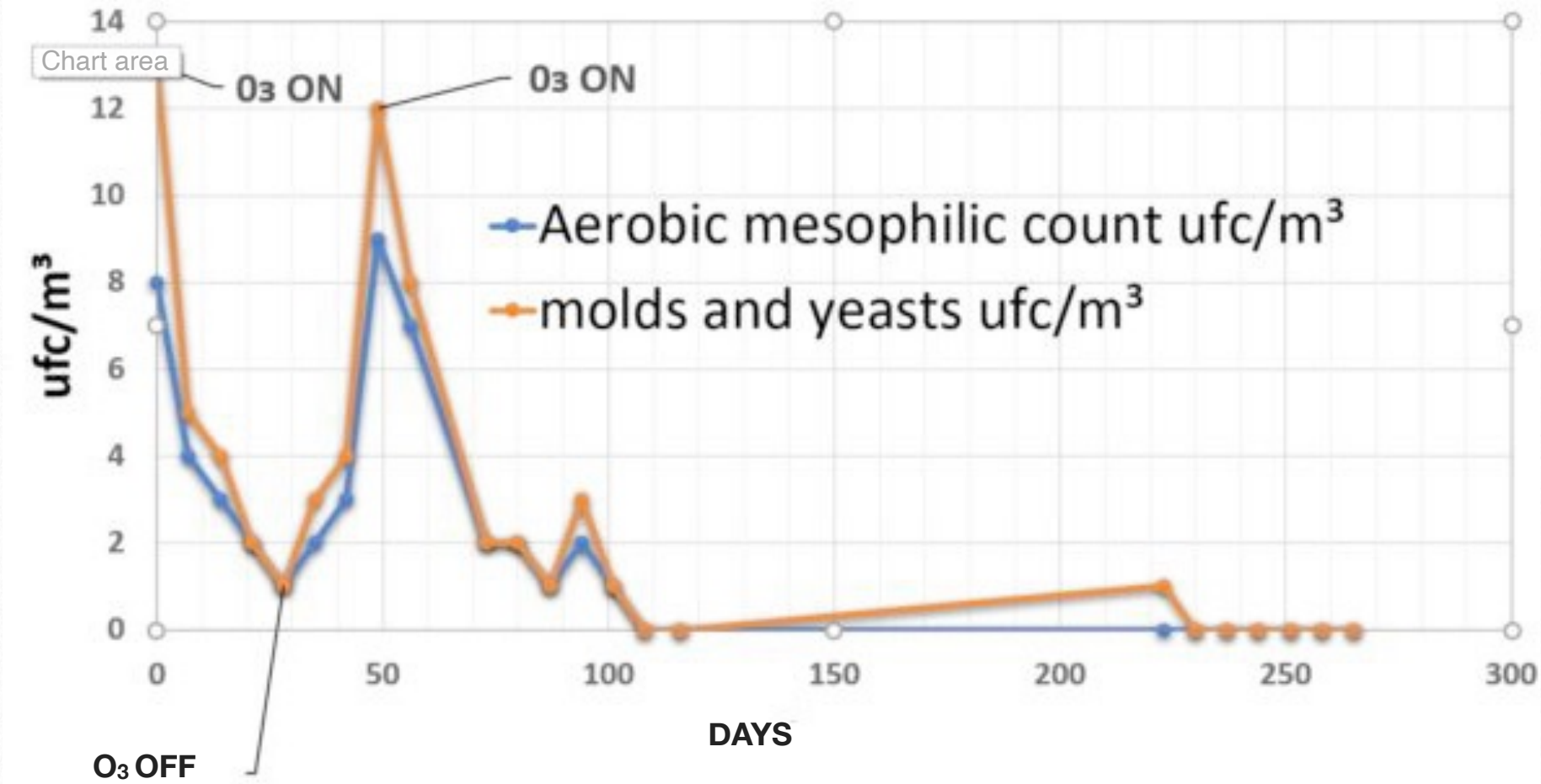
Our experience has shown us that a critical point, essential in the production of fresh pasteurized pasta or pre-cooked pasta, may very often be the cooling area. This area could be where most recontamination after pasteurization occurs as a result of moulds. Increasingly high-capacity production lines with high outputs and hermetic conditions could be new sources of contamination. Air used in the cooling system, if not systematically sanitized during the various production cycles, could become a dangerous concentrate of bacteria that may contaminate products before packaging. Unfortunately, mould is airborne and so normal sanitization procedures using contact liquids, UV lamps, fumigants or dry mists may not guarantee complete sanitization of cooling equipment. This is why we decide to install a small ozone generator to sanitize the air used to cool the product.

Systematic air sanitization is essential, not only for the air circulating inside the cooling system or in the packaging environments, but also for air entering by way of compensation from other external environments with microbiological qualities that are probably unknown. Filters and air treatment units, if not frequently sanitized, may not suffice to guarantee air quality.

The safety of ozone gas application is guaranteed by the concentration sensors installed both inside and outside the plant. These sensors guarantee not only safety, but also considerable versatility in creating sanitization protocols with different ozone concentrations. Furthermore, sanitizing with known and controlled ozone concentrations protects the structures and machinery from any risk of oxidization.

The following graph shows how continuous sanitization of the air in the cooling tunnel progressively and drastically reduces the quantity of airborne moulds. Ozone concentrations and frequency of use will be fundamental in maintaining aseptic environments.

The sanitization of production, transfer and packaging areas is often difficult to plan, organize, and execute efficiently when carried out with normal fumigants, dry mists or contact liquids. This highly effective and efficient technology means sanitization can be programmed at any time, without additional costs, no residues and guaranteed sanitization thanks to correct ozone concentrations and the ability to reach hidden and high points (e.g. filters, air ducts and ceilings). The practicality of this technology means it is possible to carry out increasingly more frequent sanitization thus guaranteeing



microbiological hygiene of the processing environments throughout the year.
Today ozone is also widely used to sanitize silos and slow drying chambers for pasta.
The action of ozone in the aforementioned environments is effective not only at a microbiological level but also at an entomological level: because the ozone reaches all spaces, it is very effective in reducing the development of eggs, larvae and consequently adult insects that could contaminate the finished product. Today an ozone solution is a sustainable choice as the gas is self-produced, is not wasted (thanks to the concentration sensors), is highly efficient in terms of energy and reduces the use of fumigants and dry mists.
This solution is also considered a technological innovation and therefore could benefit from tax incentives.

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