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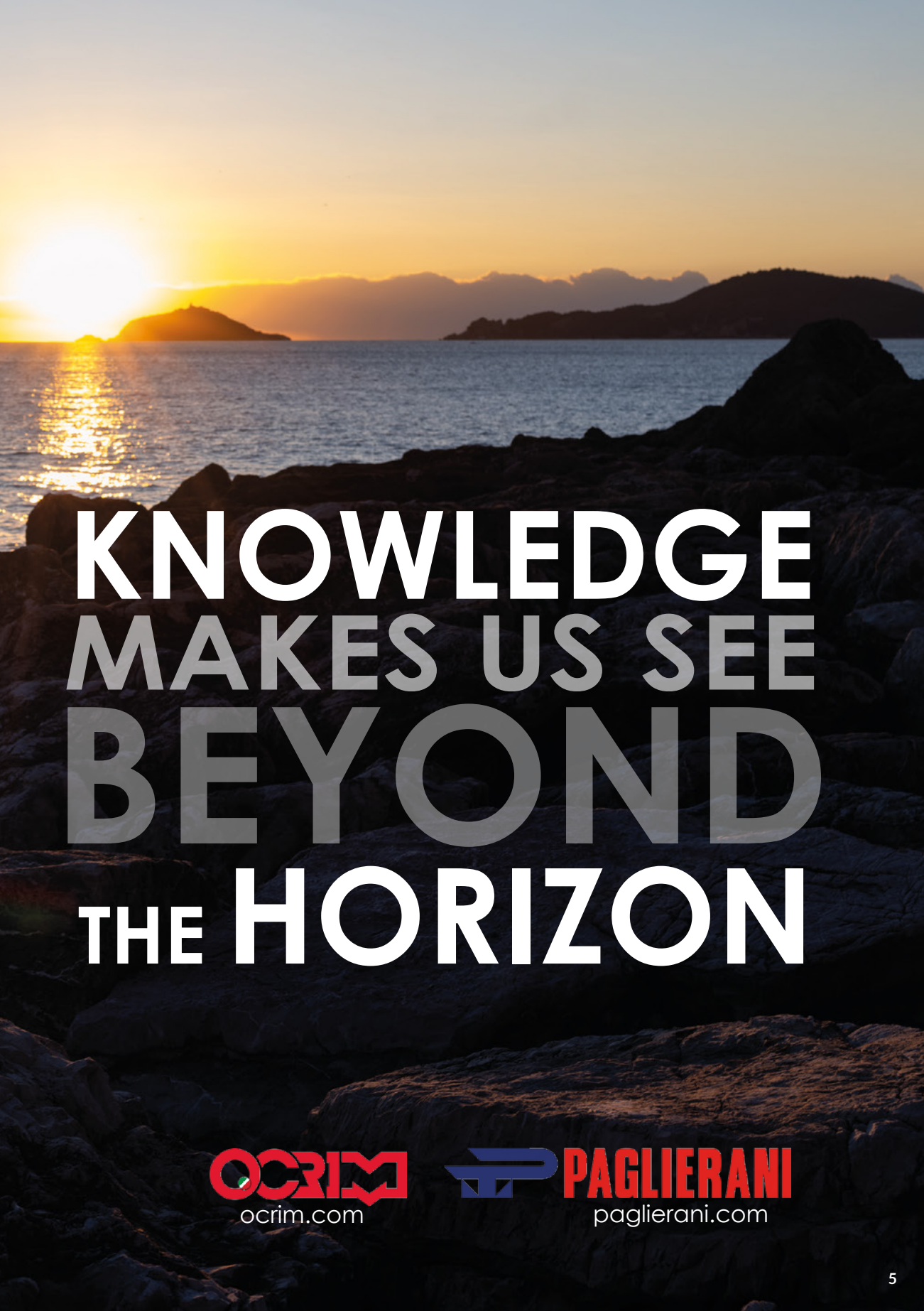
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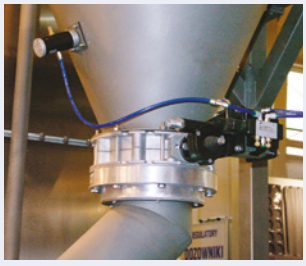

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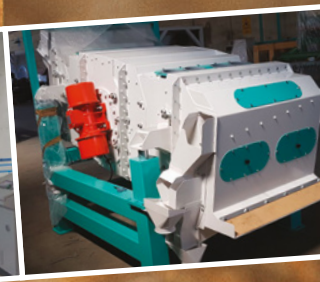








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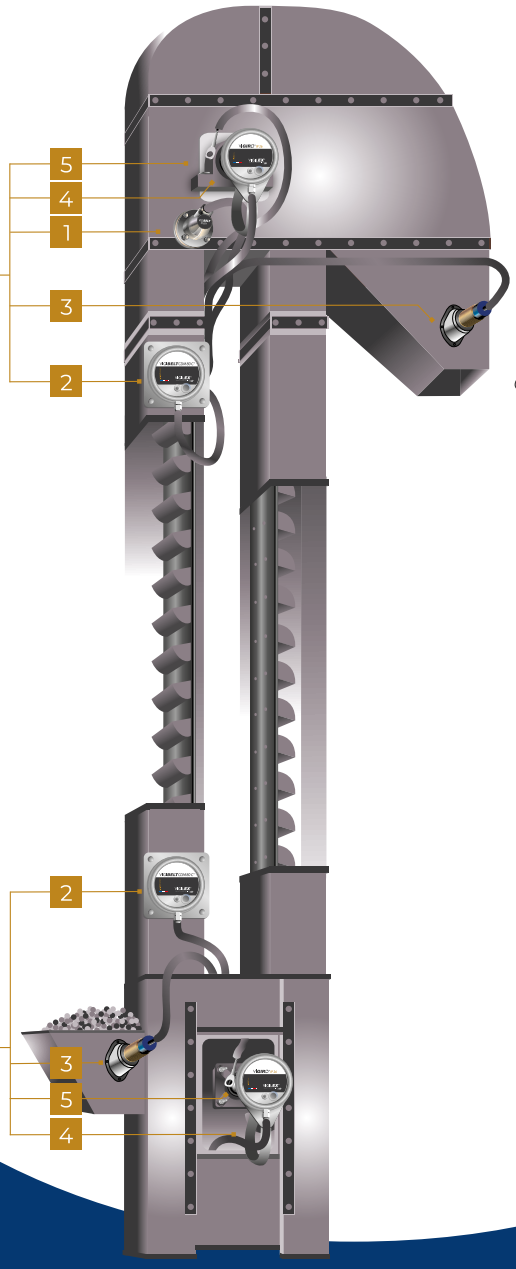

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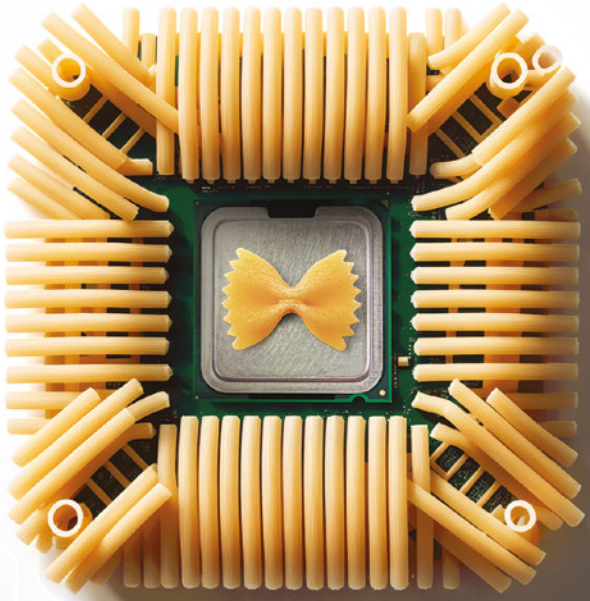

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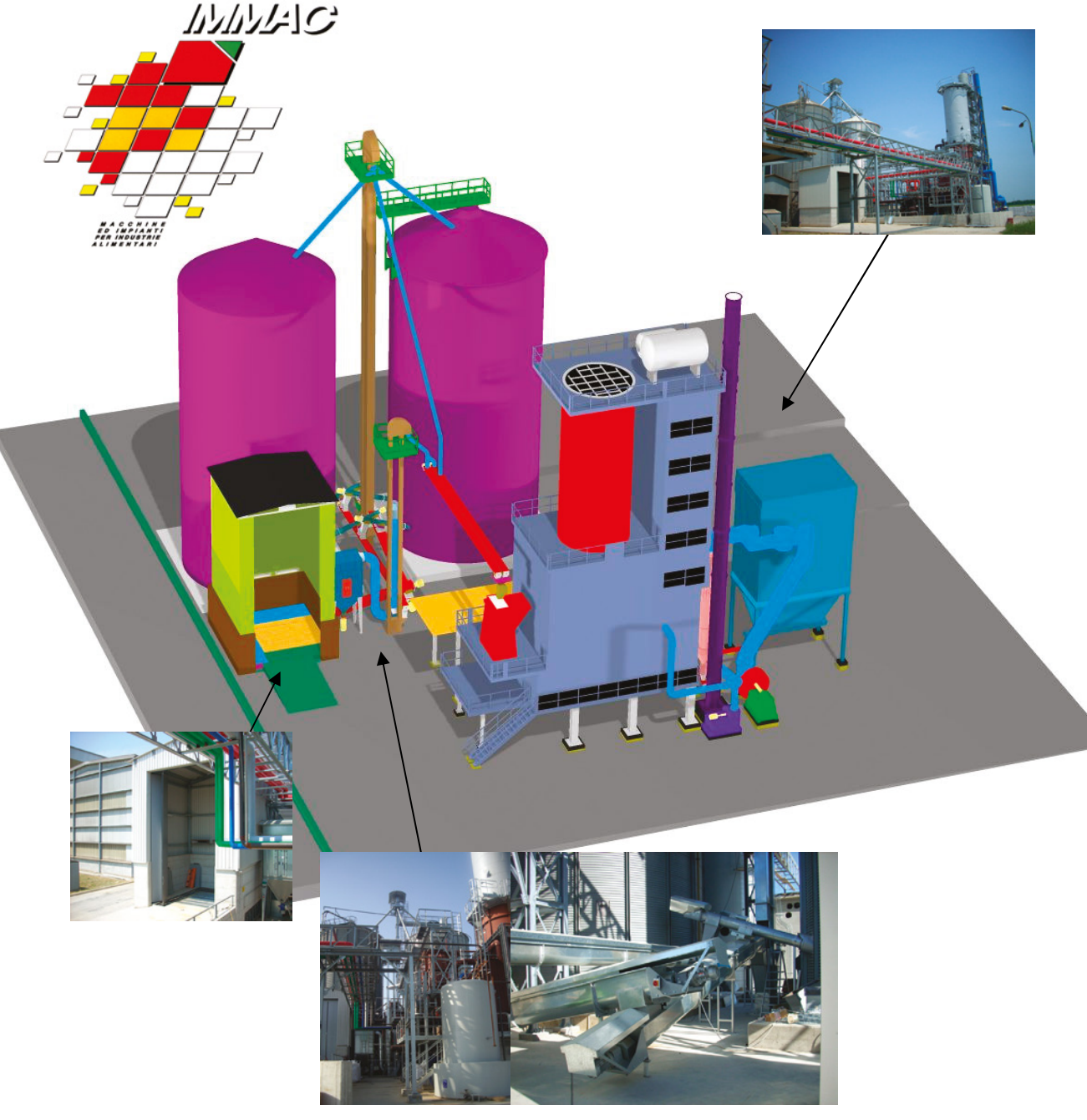

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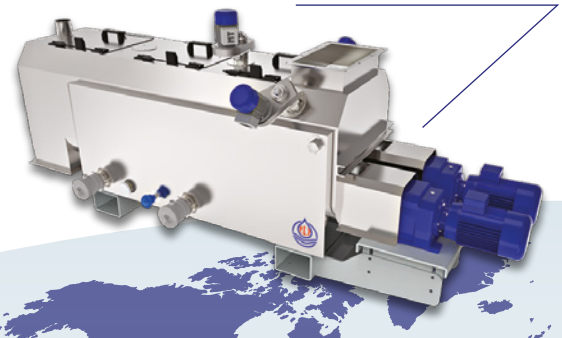

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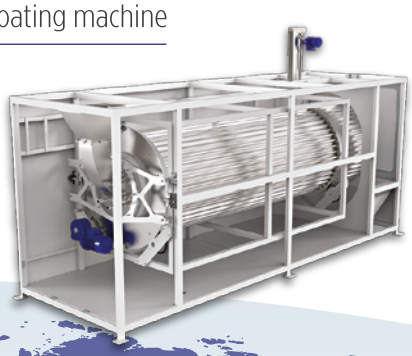

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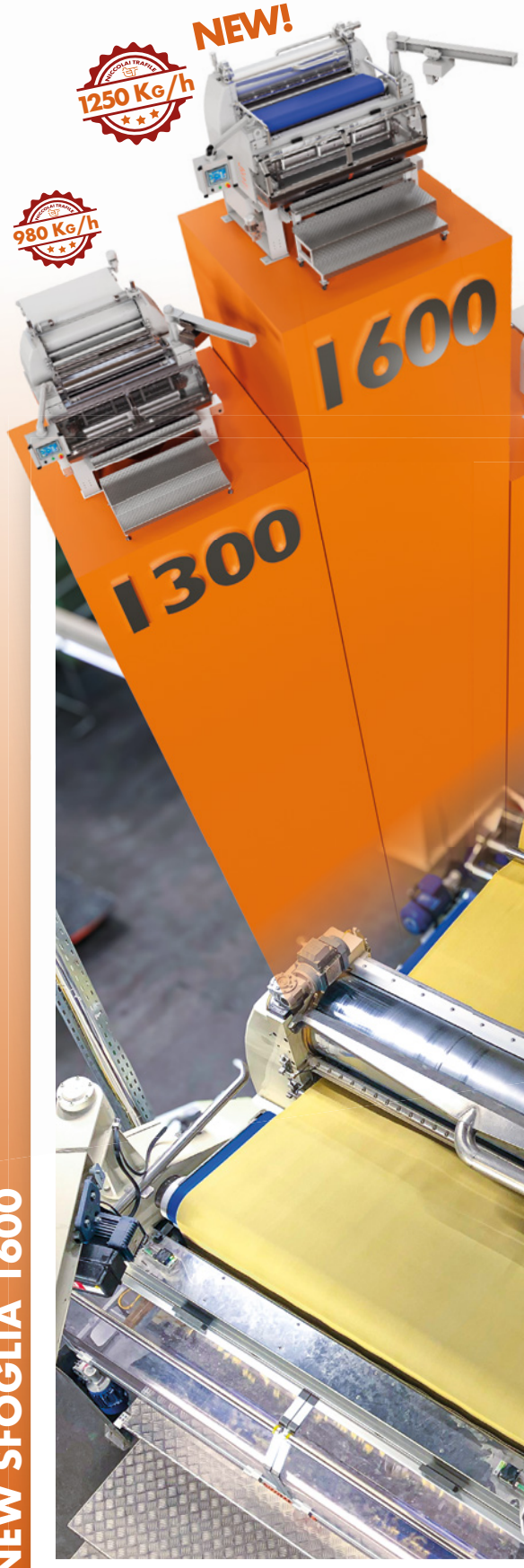

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PUBLICATION MANAGER Alberto Chiriotti

EDITOR-IN-CHIEF Livia Chiriotti

CONTRIBUTING EDITORS Simonetta Musso, Laura Sbarato, Elena Folco, Chiara Mancusi, Rossella Contato, Matteo Barboni

EDITOR Federica Diaferio: diaferio@chiriottieditori.it

CIRCULATION Monica Primo: primo@chiriottieditori.it

SUBSCRIPTIONS Marilù Cianflocca:
Tel. +39 0121 378147 - abbonamenti@chiriottieditori.it

LAYOUT DESIGNER Anna Boscolo

MARKETING MANAGER Monica Pagliardi: pagliardi@chiriottieditori.it

ADVERTISEMENT Luca Russo: russo@chiriottieditori.it

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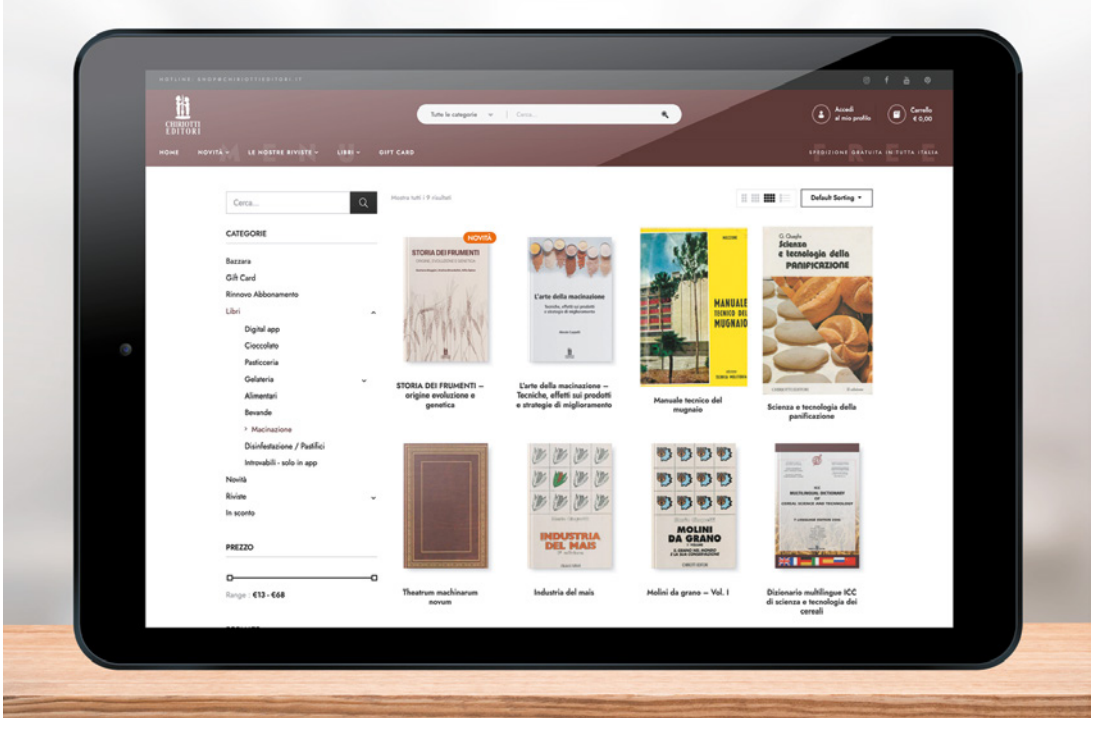

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ANCIENT WHEATS

CONTENTS

Clipping effect on the nitrogen and protein fractions of ancient wheats grown in Mediterranean

Marina Mefleh[1]* - Rosella Motzo[1] - Fatma Boukid[2] - Francesco Giunta[1]

[1]Department of Agricultural Sciences, University of Sassari
Viale Italia 39/A - 07100 Sassari - Italy
[2]ClonBio Group Ltd. - 6 Fitzwilliam Pl - D02 XE61 Dublin - Ireland
*email: marina.mefleh@uniba.it

Keywords: clipping, grain nitrogen, gluten, protein composition

ABSTRACT

This study is the first to assess the effects of clipping, cultivar, season, and their interactions on the protein composition of six old and ancient wheat cultivars (n=6). For this, nitrogen content, the proportion of wheat protein fractions, and the molecular weight distribution of the extractable and unextractable glutenin polymers were investigated as a function of cultivar and clipping in two consecutive seasons. The relationships between genotypic variation in grain nitrogen and protein fraction content under clipping and non-clipping conditions were also assessed. Clipping delayed and shortened the grain filling period of all of the cultivars. The protein composition of some cultivars behaved differently to clipping due to differences in the environmental conditions of S1 (exceptional dry season) and S2 (rainy season). In S1, clipping decreased the ratio of gliadins over glutenins (GLI/GLU) (<1) of Cappelli and Giovanni Paolo, while in S2, clipping improved the GLI/GLU of Giovanni Paolo, Monlis, and Norberto. The unextractable polymeric proteins were not affected by clipping. Khorasan was shown to be indifferent to clipping in S1 and S2. These results suggest that it is possible to have ancient/old wheats suitable for a dual-purpose system, in different climatic conditions, while maintaining good grain quality traits. The increased market demand for ancient and old wheats presents an economic opportunity for farmers who adopt the dual-purpose technique to cultivate these resilient crops again and increase their profit margins and revenues.

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INTRODUCTION

Ancient wheat species (einkorn, emmer, and spelt) were grown by ancient civilization and represent a transition from wild wheats (before domestication) to the landraces and old cultivars of durum and bread wheat. Ancient wheats are characterized by hulled and small kernels. On the other hand, landraces and old cultivars of durum wheat are free-threshed, generally tall of the cultivars, cultivated before the introgression of the dwarfing Rht-1 genes. The cultivation of ancient and old wheats decreased gradually after the Green Revolution to be replaced by the high-yielding modern semi-dwarf wheat cultivars [1]. Ancient and old wheats were therefore limited to marginal low-fertility areas where the performance of the high-yielding modern cultivars could not be achieved [2,3]. In fact, under low-input conditions, the yield of some old durum wheat cultivars has been shown to not be different from that of modern durum wheat cultivars, with old cultivars having even higher grain nitrogen content [4]. In general, the intensive cultivation of modern wheat cultivars resulted in a quantum increase in wheat grain production worldwide. Nevertheless, adopting modern cultivars resulted in wheat biodiversity loss. During the last two decades, there was increased public awareness toward the introduction of sustainable development policy and programs such as the 2030 Agenda [5]. The Sustainable Development Goals 2 and 15 are indeed devoted to the promotion of sustainable agriculture and the protection and restoration of biodiversity loss [5]. In this frame, reintegrating the cereal biodiversity of landraces and old varieties into the low-input cropping systems would play a crucial role as a source of allelic variation related to yield, grain quality, and low-input adaptability [6,7]. Moreover, reducing the input costs contributes to improved profit margins and the overall economic viability of agricultural operations, while adopting a dual-purpose crops system could be a strategy in promoting sustainability and resilience of the farming system.

Ancient and old wheat plants are tall in height and produce high vegetative biomass [8,9]. These vegetative biomasses can be grazed by sheep and cattle during their growth in many farming systems [10]. This would contribute to assuring a continuous seasonal supply of herbage to animals during critical periods (e.g., periods of low forage availability) [11] without renouncing the grains in the same season (dual-purpose utilization). Grazing the herbage before the onset of stem elongation can exert several positive effects on old and ancient wheat crops, such as reducing both the incidence of lodging [12,13] and the water used early in the season. As such, this practice increases water use efficiency during anthesis and the grain filling period (GFP) [14,15]. Tall of the cultivars are particularly suited to this type of utilization because they suffer less from grain yield reduction following grazing compared to high-yielding improved semi-dwarf cultivars [16].

In particular, Italian ancient and old durum wheats were found to be suitable for dual-purpose utilization [8,13]. Thus, adopting mixed farming systems

of ancient and old grains can increase the economic advantages of farmers in the Mediterranean environment. The dual-purpose utilization of Italian old and ancient wheats was reported to make herbage available to animals in the critical winter period, without decreasing the grain yield attainable after grazing in the same season [8,13]. However, it is still uncertain as to whether clipping affects the wheat grain protein composition or not. These latter traits are the main ones behind the wheat end-use quality and type (e.g., pasta, bakery, or pastry).

Extractable grain nitrogen (EGN) is the content of nitrogen allocated to the metabolic (albumin and globulins) and the SDS-extractable storage proteins (gliadins and glutenins) during the development and the maturation of the grain, while unextractable grain nitrogen is allocated to the SDS-unextractable polymeric proteins. These latter ones are formed via the aggregation of the glutenins, mainly the low-molecular-weight glutenin subunits (LMW-GSs), which by having a greater amount of free SH groups undergo redox change simultaneously with continuous grain dehydration [17]. The proportion of the different wheat protein classes, the molecular weight distribution of the glutenin polymers, and the percentage of the unextractable polymeric protein (UPP%) are relevant indicators to predict the rheological properties of dough [4,18] and the quality of wheat-based products [19].

In a previous study of our group, the clipping of a set of ancient species and old wheat cultivars delayed the flowering time to different extents depending on the cultivar and reduced the total nitrogen (N) present in the crop at anthesis and the grain protein percentage and content [10]. The present study aims to go further in investigating the effect of clipping on the protein composition of the same set of wheat. To the best of our knowledge, this study is the first to investigate the effect of clipping, cultivar, season, and their interactions on the protein composition of six wheat cultivars belonging to four species of the genus Triticum (emmer, einkorn, durum, and turanicum).

MATERIAL AND METHODS

Site, Soil, and Agronomic Management

A two-year trial was conducted during the 2017/2018 and 2018/2019 periods at the Ottava experimental station (41° N; 8° E; 80 m a.s.l) of the University of Sassari. The station is situated in a Mediterranean environment with an average annual rainfall of 539 mm, primarily occurring between October and April. The soil contains a layer of limestone at a depth of 0.4 to 0.5 m, has 45 kg ha^{-1} of mineral nitrogen, 1.4±0.3% soil organic matter content, 40±4.4% total $CaCO_3$ content, and 8.4±0.5 ppm available phosphorus. The fertilization process involved two separate applications. At sowing, nitrogen and phosphorous were applied in the form of diammonium phosphate at rates of 36 kg ha–1 of N and 92 kg ha^{-1} of P2O5. Following clipping, 26 kg ha^{-1} of ammonium nitrate was applied (2nd application) to both the clipped and non-clipped plots. The previous crop was faba bean in both seasons, and a seed-

bed was prepared by ploughing the soil to a depth of 0.25 m followed by surface cultivation. Weeds, pests, and diseases were controlled using chemical treatments. The sowing rate was set to 200 viable seeds per m^2. The experimental fields were sown on 25 and 26 October in the first and second season, respectively.

The field experiments analyzed in this study were also the subject of the work published by [8] on grain yield and the suitability of ancient wheat species to dual-purpose utilization.

Factors, Treatment, and Design of the Experiment

The field experiment was laid out in four blocks as a split-plot. The cultivar factor was assigned to the main plot, while the clipping factor was assigned to the subplot. Each plot measured 10 m^2 and contained 6 rows that were 8.4 m long, with spacing of 0.15 m between rows. Two fields were used in the study over the two-year period. Clipping was performed using a lawn mower when the terminal spikelet stage was detected, limiting the aboveground plant height to a maximum of 2 cm in the "clipped" treatment. The six wheat cultivars used in the study (**Tab. 1**) were "Monlis" and "Norberto", two einkorn cultivars, "Padre Pio" and "Giovanni Paolo", two improved emmer cultivars selected for their adaptability and resistance to diseases and lodging, an old durum wheat cultivar called "Senatore Cappelli", and an old turanicum wheat variety called 'Khorasan'. The experiment was conducted in the two seasons of 2016/17 (S1) and 2017/18 (S2).

All of the agronomic measurements performed in this study (emergence, flag leaf appearance, anthesis, physiological maturity, number of leaves, lodging incidence, and biomass samplings at termi-

Table 1 - Characteristics of the studied wheats.

Species	Cultivars	Geographic or Genetic Origin	Year of Release
Triticum durum Desf.	Senatore Cappelli (Cappelli)	North-African landrace Jean Retifah	1920
Triticum turanicum	Khorasan	Near and Central Asian landrace Jakubz	2019
Triticum monococcum ssp *monococcum*	Monlis	Genealogical selection of local population	2006
Triticum monococcum ssp *monococcum*	Norberto	Genealogical selection of local population	Known before 2018 as ID331
Triticum dicoccum Schubler Improved Emmer	Giovanni Paolo	*Triticum dicoccum* Schubler line selected from Molise population × *T. turgidum* spp. *durum* Desf. cv Simeto	2008
Triticum dicoccum Schubler Improved Emmer	Padre Pio	*Triticum dicoccum* Schubler line selected from Molise population × *T. turgidum* spp. *durum* Desf. cv Simeto	2008

nal spikelet, anthesis, and maturity) were described in [8]. As already mentioned in [8], one of the limitations of the use of old and ancient cultivars is their high susceptibility to lodging. Clipping reduced but did not eliminate lodging, which caused some technical problems at harvesting.

Meteorological Data

Meteorological data such as maximum and minimum temperatures, rainfall, solar radiation, and air relative humidity were monitored by a meteorological station approximately 300 m away from the field. Data were used to calculate the minimum and maximum temperatures and the number of days with temperatures higher than 25° and 30°C.

Grain Weight and Nitrogen Content

Grain moisture content and grain weight were obtained from four 250-grain subsamples per plot. Nitrogen percentage was determined on each subsample by means of a Carbon/Hydrogen/Nitrogen Analyzer (628 Series, LECO Corporation, St. Joseph, MI, USA) [19]. The combustion temperature was set at 1050°C. Nitrogen data were used to calculate the amount of nitrogen (in µg) per grain (total grain N) as grain weight at dry basis × N percentage.

Protein Characterization

Sequential Extraction of Gliadin and Glutenin for Reverse-Phase High-Performance Liquid Chromatography (RP-HPLC) Analysis

Albumin and globulin, gliadin, and glutenin extraction and quantification were performed as previously described [4]. The relative percentage of each protein fraction (albumin-globulin, gliadin, and glutenin) was calculated from the total protein, and the relative percentage of each glutenin subunit (HMW and LMW) was calculated from total gluten. The ratio of gliadin/glutenin was calculated as the ratio of the gliadin peak over the glutenin peak. The chromatograms of gliadins and glutenins are present in **Figg. S1** and **S2** of the Supplementary Materials.

Extraction of Extractable and Un-Extractable Polymeric Proteins for Size-Exclusion High-Performance Liquid Chromatography (SE-HPLC) Analysis

Protein extraction and quantification were performed as previously described by [4]. The total area under each chromatogram obtained from SDS-extractable and un-extractable protein extracts was expressed as a percentage (EP% and UP%, respectively) of the sum of the total area of both chromatograms. The un-extractable polymeric protein fraction (UPP%) was calculated as a percentage of the total polymeric protein (UPP%=UP%/(sum of glutenins% of EP) + UP%).

Grain nitrogen data and the percentages of protein fractions (determined using RP-HPLC) and the percentage of EP and UP (determined using SE-HPLC) were used to estimate the µg of nitrogen of each protein fraction and subunits and the nitrogen content of EP and UP [4]. From here on, the ug of nitrogen content of a fraction or subunit will simply be referred to as 'content'; for example, the µg of nitrogen of gliadin will be referred to as 'gliadin content', as in Mefleh et al. [4].

Statistical Analysis

For each season × cultivar × clipping combination, grain samples of 200 g each from the four field blocks were grinded together for subsequent chemical analysis, which was conducted in triplicate. Data were analyzed using R software (R Core Team, 2014, Vienna, Austria). Factorial analysis of variance was conducted to evaluate the effect of clipping, cultivar, and season, as well as their interactions. The Pearson correlation coefficient was used to evaluate the existence of causal relationships between pairs of traits.

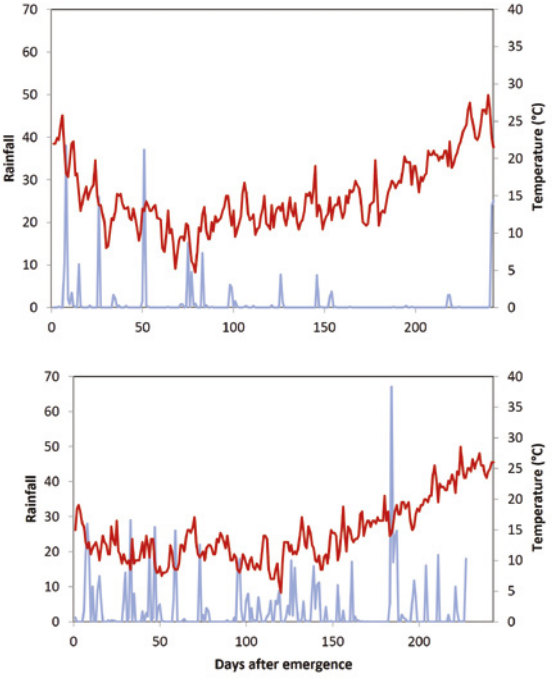

Fig. 1 - Weather for S1 (2016) (upper panel) and S2 (2017) (lower panel) from emergence (1st November) to maturity. Rainfall (blue solid lines) and mean air temperature (red line).

RESULTS AND DISCUSSION

Weather conditions and phenology

Weather conditions and phenology have been partly discussed in [8] with reference to their effects on biomass and grain yield under dual-purpose utilization. In this analysis, the focus is on the grain filling period (GFP), and hence on the weather conditions during the period when the nitrogen allocation to protein fractions is determined. The climatic conditions determined by the two seasons were markedly different in terms of pluviometry with regard to amount, distribution, and thermal regime, and thus affected water status and the response to temperature of the crop during both vegetative and reproductive phases differently (**Fig. 1**). During S1, only 311 mm of rain fell between October and June, which represents 40% of the rainfall in S2 (785 mm). The GFPs of all of the cultivars were longer in S2 than in S1 due to the higher rainfall during S2. However, the GFP in S2 intercepted more days (34 days), with average temperatures above 25°C, compared to S1 (24 days) (Fig. 1).

The great phenological differences between cultivars were reflected in the different duration of the vegetative growth (that lasted until clipping) and in the start and end of the GFP (**Fig. 2**). According to the duration of the grain filling period, roughly considered to be coincident with flowering-ripening, we can distinguish three different groups of cultivars: (a) Giovanni Paolo was the earliest in flowering and had the longest GFP (around 2 months), (b) Cappelli, Khorasan, and Padre Pio had a GFP of around one month

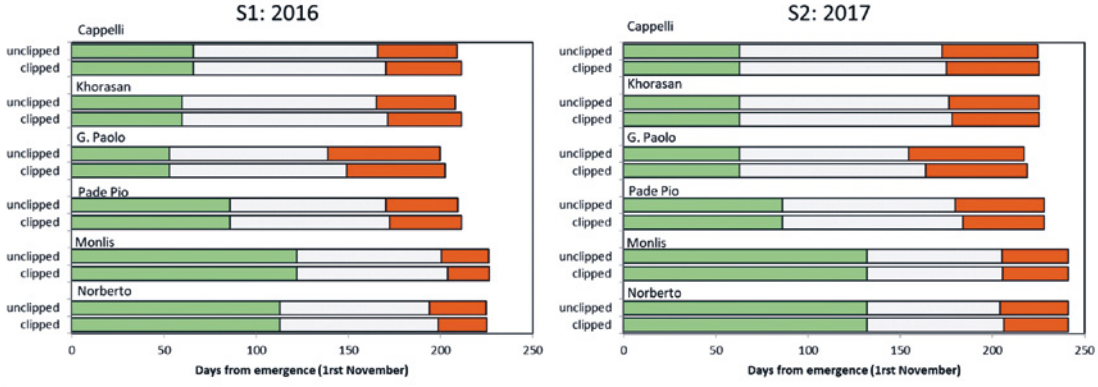

Fig. 2 - Effect of season, cultivar, and clipping on the length of the vegetative growth (from emergence until clipping, in green and from clipping until flowering, in white) and on the grain filling period (from flowering until physiological maturity, in orange).

and a half, and (c) Monlis and Norberto were characterized by being the latest in flowering and having the shortest GFP (around a month).

Clipping delayed flowering by 6 days on average in S1 and by 3 days in S2, with the greater delay (9-10 days) observed in Giovanni Paolo (Figure 2). On average, clipping shortened the GFP by 3.3 days in S1 and by 3.0 days in S2. However, the GFPs of all of the cultivars, except for Giovanni Paolo, were longer in S2 compared to S1 due the high rainfall of S2.

Cappelli, Khorasan, and Padre Pio suffered a rainfall deficit in S1 but not in S2, while the other cultivars suffered a rainfall deficit in both seasons (**Tab. 2**). In fact, Hinson et al. [20] found that limited early season precipitation resulted in slow forage growth in all years and

Table 2 - Meteorological data during the grain filling of the six cultivars in the first (S1) and second (S2) season.

Cultivar	Onset of Grain Filling	Duration of Grain Filling (d)	Rainfall (mm)	Rainfall Deficit (mm)	Minimum Temperature (°C)	Maximum Temperature (°C)	N° of Days with 25 °C < T < 30 °C	N° of Days with T > 30 °C
S1								
Giovanni Paolo	15 March	57	16	−279	10	21	0	13
Cappelli, Khorasan, Padre Pio	15 April	41	1	−208	11	24	0	13
Monlis, Norberto	15 May	26	6	−164	14	26	2	20
S2								
Giovanni Paolo	1 April	59	240	−6	13	22	10	2
Cappelli, Khorasan, Padre Pio	20 April	49	238	17	15	24	15	4
Monlis, Norberto	20 May	36	73	−135	19	29	22	11

Table 3 - Sum of squares percentage from ANOVA and significance of the F test for the effects of clipping, cultivar, season, and their interactions on extractable grain nitrogen (EGNμg), unextractable protein (UP%), and unextractable polymeric protein (UPP%) percentages, protein fractions, and ratios.

	Cultivar	Clipping	Season	Cultivar × Clipping × Season	Cultivar × Clipping	Clipping × Season
EGNμg	***	**	***	ns	ns	ns
	90.05	3.27	4.88	0.66	0.61	0.53
UPP%	***	ns	**	ns	ns	ns
	89.3	1.67	3.36	2.44	3.22	0
UP%	***	ns	***	ns	ns	ns
	84.92	0.54	9.45	2.86	1.6	0.63
μg of N in Albumins and Globulins	***	*	*	*ns*	***	**
	56.23	0.88	3.76	6.5	12.6	20.04
μg of N in Gliadins	***	ns	ns	***	***	***
	51.35	0.18	0.4	16.16	17.15	14.75
μg of N in Glutenins	***	**	**	***	***	***
	42.96	3.54	3.67	20.86	13.52	15.44
GLI/GLU	***	*	ns	***	***	***
	32.06	5.2	0.31	20.69	23.04	18.7
HMW/LMW	***	ns	ns	***	***	***
	74.63	0.36	0.1	6.62	15.25	3.04

ns: not significant; *: p≤0.05; **: p≤0.01; ***: p≤0.001; SS: sum of squares. GLI/GLU: ratio of gliadins over glutenins; HMW/LMW: ratio of high-molecular-weight over low-molecular-weight glutenin subunits.

inadequate forage production. The average of the minimum temperatures of S2 were higher than the ones of S1 for all of the cultivars. The late flowering of Monlis and Norberto combined with the delay induced by clipping resulted in grain filling taking place in the month of June, when crops were exposed to more days with temperatures between 25° and 30°C (22 days compared to 10 and 15 for the other cultivars) and also to more days with maximum temperatures exceeding 30°C (11 days compared to 4 and 2 for the other cultivars). In S2, the number of days with maximum temperatures exceeding 30°C was lower than in S1.

Grain nitrogen content, protein composition, and quality

EGNμg was significantly influenced by clipping, cultivar, and season, while their interactions did not show any significant effects (**Tab. 3**). Cultivar was the main factor impacting EGNμg. Giovanni Paolo and Khorasan had the highest EGNμg, almost double the values of Monlis and

Norberto (**Tab. 4**). This can be related to differences in grain weight, i.e., 50 and 55 mg, for Giovanni Paolo and Khorasan, respectively, against 23 mg for Monlis and 26 mg for Norberto [8]. EGNµg was found to be higher during S2 compared to S1, and this might be due to favorable weather conditions for grain filling [21].

Tab. 4 showed that a reduction in EGNµg was observed after clipping. This result is not consistent with studies conducted on the grain nitrogen of triticale [22], common wheat [23], and hard red and white winter wheats [24]. This discrepancy might be due to the use of different cultivars grown under different environmental conditions. In our study, EGNµg was not affected by the interaction of clipping × season. This contrasts the work of [23], whereby the authors reported contrasting effects of clipping on grain N content depending on the environmental conditions, with dry seasons resulting in greater N recovery after clipping, compared to favorable rainy seasons.

Table 4 - Extractable grain nitrogen (EGNµg), unextractable protein (UP%), and unextractable polymeric protein (UPP%) percentages as a function of clipping, cultivar, and season. Values (mean ± standard deviation) in the same column flanked by different letters (a-e) are significantly different (p≤0.05) based on Tukey's test.

Factor	EGNµg	UP%	UPP%
Clipping	*	ns	ns
NC	893	8.12	29.3
C	814	8.41	29.8
Cultivars	***	***	***
Cappelli	929 b	6.37 c	33.9 bc
Giovanni Paolo	1095 a	10.6 a	36.6 a
Khorasan	1027 a	8.26 bc	31.4 d
Monlis	533 c	10.7 a	34.1 b
Norberto	614 c	9.32 ab	32.6 cd
Padre Pio	925 b	4.37 d	28.3 e
Season	***	***	**
S1	806	9.00	30.0
S2	902	7.54	29.2

ns: not significant; *: p≤0.05; **: p≤0.01; ***: p≤0.001. NC: not clipped; C: clipped.

Regarding the cultivar effect (Tab. 4), Giovanni Paolo, Monlis, and Norberto evidenced the highest UP% and Giovanni Paolo had the highest UPP%, while Padre Pio had the lowest values. UPP% is strictly related to gluten strength and dough strength and stability [4]. All of the cultivars, except Padre Pio, had an UPP% higher than 20%, the threshold for weak dough [25], and can be classified within the category of "high UPP%" according to [26]. On average, the UPP% of the set of wheats studied was higher than a previous study focusing on a set of 16 Italian durum wheat cultivars [4]. This can be related to species as well as varietal and/or environmental differences. Edwards *et al*. [27] showed that UPP% is directly associated with genes located on Glu-B1 known to encode HMW-GS. In particular, the weak versions (e.g., HMW-20) have the lowest UPP% compared with the strong versions (e.g., HMW-7+8, 6+8) in terms of pasta and bread quality. Even if Monlis and Norberto are two diploid wheats lacking Glu-B1 genes, they had a high UPP% when compared with the other tetraploid cultivars. This suggests that UPP% is closely linked to Glu-A1, independently of Glu-B1. The high UPP% of Monlis and Norberto could be due to their late GFPs (even though they were

short GFPs), resulting in more days with high temperatures (>30°C) than the other cultivars. In fact, during the last stage of the GFP, as the grain dehydration progresses, the activity of glutathione reductase decreases and this leads to the formation of mixed disulfides between glutathione and glutenins, which is the UPP formation [28].

S2 was characterized by a longer GFP, greater water availability, and less days with maximum temperatures greater than 30 °C than S1. The low UPP% during S2 was likely a consequence of a shorter dehydration period. The decrease in UPP% was found independent to changes in total grain protein and gluten content [18].

Tab. 3 reveals that cultivar significantly impacted all grain protein fractions and ratios, while season and clipping had limited or unsignificant effects. Arzadun *et al*. [29] showed that even the quality of yield and forage after clipping were mainly influenced by cultivars. Clipping impacted soluble proteins, glutenins, and the gliadins/glutenins ratio (GLI/GLU) but did not have an effect on gliadins and the HMW/LMW ratio (HMW/LMW). Season only had significant effects on soluble proteins and glutenins. Remarkably, interactions were found to be highly significant for the majority of variables, underlining the fact that cultivars responded differently to clipping in each season.

Tab. 5 illustrates the variability in protein composition as a function of clipping and cultivar in both seasons. In the dry season of S1, clipping significantly reduced the gliadin content of Cappelli and Giovanni Paolo (by almost half), while it increased glutenin, albumin, and globulin contents, leading to a strong decrease in GLI/GLU (from 2.71 to 0.4 and 2.90 to 1.24, respectively). It has been reported that low GLI/GLU is associated with an increase in the dough resistance to extension, which could interfere negatively with the dough fermentation process (development time and stability) [19,30]. In fact, gliadins and glutenins differently influence dough rheological properties. In particular, monomeric gliadins impact dough viscosity and extensibility, while polymeric glutenins confer dough cohesivity and elasticity [19]. Few researchers have investigated the role of non-gluten proteins on the quality of flour, dough, and wheat-end products. In particular, globulins were found to improve the disulfide bond formation and protein aggregation under high temperatures (100°C) [31].

Padre Pio had the highest HMW/LMW (above 0.30) in both the clipped and non-clipped treatments. High HMW/LMW was found to be related to low UPP%, weak dough and gluten quality, and thus poor bread making quality [27]. The HMW/LMW of Khorasan was impacted by clipping, without interfering with the total glutenin content. The protein fractions did not change as a function of clipping in the other cultivars, despite the stressful environmental conditions. This indicates their high ability to cope with these combined stresses (clipping and water deficit).

In the rainy season, S2, the protein compositions of Giovanni Paolo, Monlis, and Norberto were significantly influenced by clipping. Their albumins, globulins, and glutenins contents decreased

by 40-60% and by 60-73%, respectively, in response to clipping. However, the gliadin contents of the clipped grains increased 1.9-2.9 times, leading to a 6-10 times increase in their GLI/GLU ratio. Under the non-clipped conditions, Giovanni Paolo, Monlis, and Norberto had a GLI/GLU≤1, meaning that the tenacity of their dough exceeded the extensibility. This might negatively impact dough fermentation and thus limit bread volume. Therefore, the notable increase in GLI/GLU due to clipping makes them more suitable, at least for these dough traits, for fermented end-products compared to the non-clipped ones [19]. The protein fractions of Padre Pio did not differ significantly after clipping; however, the GLI/GLU decreased, and so its dough extensibility did too. Clipping also lowered its HMW/LMW to less than 0.30, improving its dough quality. The same applied to the HMW/LMW of Khorasan, while that of Giovanni Paolo increased to be over 0.30. A change in HMW/LMW means that the changes in the glutenin subunits, re-

Table 5 - Effects of clipping on the protein fractions and their ratios of the six cultivars in the first (S1) and second (S2) season.
(S1) and second (S2) season.

	µg of N in Albumins and Globulins		µg of N in Gliadins		µg of N in Glutenins		GLI/GLU		HMW/LMW	
	NC	**C**	**NC**	**C**	**NC**	**C**	**NC**	**C**	**NC**	**C**
S1										
Cappelli	241	411	540	149	199	369	2.71	0.40	0.18	0.20
Giovanni Paolo	182	275	634	329	218	352	2.90	1.24	0.24	0.30
Khorasan	232	261	685	632	178	173	3.85	3.65	0.28	0.24
Monlis	76.0	79.0	248	247	100	97.0	2.48	2.53	0.25	0.24
Norberto	89.0	86.0	344	314	114	98.0	3.04	3.21	0.25	0.26
Padre Pio	206	196	600	515	115	87.0	5.20	5.96	0.32	0.34
$LSD_{0.05}$	*53.8*		*143*		*65.5*		*0.91*		*0.02*	
S2										
Cappelli	241	198	577	466	112	155	3.75	4.18	0.20	0.19
Giovanni Paolo	353	216	246	707	679	186	0.37	3.82	0.30	0.35
Khorasan	276	223	607	544	188	140	3.23	3.88	0.27	0.21
Monlis	203	203	223	412	236	67.0	1.02	6.18	0.24	0.24
Norberto	286	116	152	433	313	138	0.48	3.15	0.25	0.26
Padre Pio	229	194	617	558	181	213	3.41	2.60	0.37	0.25
$LSD_{0.05}$	*41.8*		*64.2*		*63.7*		*0.39*		*0.09*	

NC: non-clipped; C: clipped; GLI/GLU: ratio of gliadins over glutenins; HMW/LMW: ratio of high-molecular-weight over low-molecular-weight glutenin subunits. LSD0.05: least significant difference (p≤0.05) for the comparison of means.

sulting in the overall glutenin change, were not of the same entity.

Overall, Giovanni Paolo was the only cultivar showing a significant effect of clipping to protein composition in both seasons. Probably, this might be correlated to its earliest and longest GFP (Table 2) when compared to the cultivars studied. In fact, the role of phenology is generally recognized as being one of the main drivers of adaptation and cultivar x environment interaction [29,32,33].

Relationship between genotypic variation in grain nitrogen content and protein fractions

It has been shown that genotypic differences in the grain nitrogen content can account for at least a part of the variation in quality parameters and in the partitioning of total grain N between protein fractions [4]. To evaluate whether clipping affects these relationships, cultivar means were used to calculate the relationships between albumin and globulin, gliadins, and glutenins with EGNμg under clipped and non-clipped treatments. These relationships provided information about the strength of the relationship between genotypic variation in protein fractions and the EGNμg (coefficient of correlation and determination), and the extent of the variation in protein for each unit of variation in total grain N or partitioning coefficient (slope of the regression).

As shown in **Fig. 3**, in both the non-clipped and clipped treatments, gliadins were present in larger amounts than glutenins, albumins, and globulins, in agreement with previous studies [4]. In the non-clipped treatment, the fraction of albumins and globulins was the one most tightly associated with EGNμg, which accounted for 93% of its genotypic variation, compared with 66% for gliadins. On the contrary, the genotypic polymeric glutenin content varied independently from EGNμg (R^2=0.20 ns). Our results confirm previous results [4] on old durum wheats, where albumins and globulins were more associated with total grain N than the storage proteins, but contradict their results on glutenins also being associated with GNug. The high variability in the genes coding for glutenins between the cultivars selected could be behind the discrepancy in the results.

Gliadin was also the fraction that varied the most in response to the genotypic variation in EGNμg with a slope of regression almost three times higher than that of albumins and globulins (0.60±0.39 vs. 0.19±0.66 μg of N). This result is in accordance with what was previously found in a set of durum wheats [4]. This could be because albumins and globulins are sink limited, and therefore a variation in grain nitrogen is less likely to influence the quantity of N allocated to the albumins and globulins. On the other hand, even though the accumulation of gliadins and glutenins are limited sources, they could behave differently because most of the genes behind glutenin and gliadin regulation are diverse and perform differently [34]. This means that the variability existing between the cultivars affected the relationship between EGNμg and glutenins. Clipping interfered with this relationship because, under clipped conditions, the metabolic and storage proteins varied independently from total grain N. The lack of associations

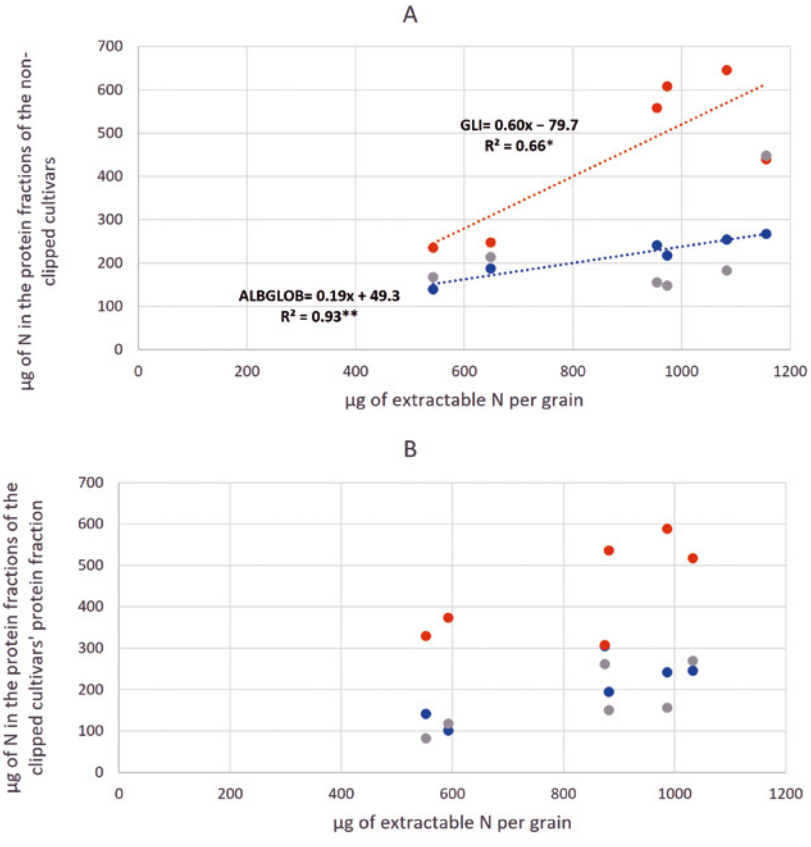

*Fig. 3 - Relationships between the variation in the grain extractable nitrogen (x) and the N content of the protein fractions (y): albumin and globulins (ALBGLOB) (blue dots), glutenins (GLU) (gray dots), and gliadins (GLI) (orange dots), under non-clipped (A) and clipped (B) conditions. Points are cultivar means across seasons. ** p≤0.01, * p≤0.05. Non-significant relationships are not reported.*

between protein formation and EGNµg under clipped conditions suggests that this technique could alter the partitioning of N to the different protein fractions. During grain filling, the albumins and globulins, as well as the gliadins and glutenins, do not start to accumulate together [21,35]. Consequently, any change in the GFP could differently affect their accumulation depending on the cultivar studied. Under non-clipped and clipped treatments, the variation in GLI/GLU was not associated with the variation in total grain N [8], confirming previous results [4] but contrasting the result by [36].

CONCLUSIONS

The primary objective of managing dual-purpose crops is to optimize the earnings generated by both harvested forages and grains, once ensuring that the grain quality remains unchanged. Moreover, the demand for ancient and old wheats and their derived products has been steadily increasing due to changing consumer preferences and the growing interest in traditional and heritage foods. Our results confirm that clipping may modify grain protein fractions, at least for the set of

studied wheats and under the climatic conditions of this study. This could affect the grain's quality traits and consequently the rheological properties of the dough and their suitability for food applications, mainly pasta and bread. Khorasan was the only cultivar not to be affected by clipping and to have an unchangeable protein composition (which could imply an unchanged quality of flour, dough, and end-product). For other cultivars, the effect of clipping on protein accumulation was significant and could be considered to be positive or negative depending on the climatic conditions of the season and on the type of the end-product desired. These results might be valuable for agronomists and farmers adopting or willing to adopt mixed farming practices under low-input conditions.

Capitalizing on the trend of cultivating ancient and old wheats and ensuring a high quality of forages, grain yield, and technological quality via the clipping technique can lead to expanded market reach and potential growth in sales volumes, thereby boosting overall farm revenues and profitability.

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Updates on the global cereals and oilseeds market

From the February bulletin of the US Department of Agriculture (USDA), it emerges that for 2023/24 global wheat production and trade are forecast higher this month, though still below last year's records. Production is estimated higher for Iraq and Argentina. Imports are forecast up this month for the European Union, Pakistan, and Afghanistan, more than offsetting a reduction for China. Exports are raised for Ukraine, Argentina, Australia, and Turkey, but lowered for the United Kingdom and India. Record global consumption is raised even higher this month, as higher food, seed, and industrial use is only partially offset by lower feed and residual use. Global stocks are lowered this month, still at the lowest level since 2015/16. The U.S. season-average farm price forecast remains at 7.20 $/*bushel*.

Rice

Global production is forecast higher this month mainly on a larger crop in Sri Lanka. Total imports are forecast virtually unchanged as an increase for Indonesia and the Philippines offset a decrease for China. Global consumption is up with more imports for Indonesia and the Philippines. Global stocks are forecast nearly unchanged as lower stocks in China are mostly offset by higher stocks in Indonesia and Vietnam.

Corn

Global production is forecast down this month, primarily on a smaller crop in Brazil. Global trade is forecast down slightly, as cuts to Brazil, India, and Serbia are mostly offset by higher exports for Argentina, Ukraine, and Pakistan. Imports are down on trimmed forecasts for Bangladesh and the European Union. The U.S. season-average farm price is unchanged at 4.80 $/*bushel*.

Oilseeds

The global oilseeds production forecast is lowered this month to 659 million tons on large reductions in Brazil soybean and China sunflowerseed crops, more

than offsetting higher Bolivia soybean and India rapeseed crops. Global oilseeds trade is down slightly to 197 million tons on lower U.S. soybean exports, despite higher Brazil soybean exports. Ending stocks are up more than 2 million tons due to increases in U.S. and Brazil soybean and Australia rapeseed ending stocks. Oilseed crush is down slightly on lower China sunflowerseed and Vietnam soybean processing with increases in India rapeseed and soybean crush. Global protein meal exports are forecast up on higher exports of soybean and rapeseed meal from India. Vegetable oil trade is slightly down on lower Malaysia palm oil exports. The projected U.S. season-average farm price for soybeans is lowered 10 cents to 12.65 $/*bushel*.

EU production and consumption forecasts for 2023/24

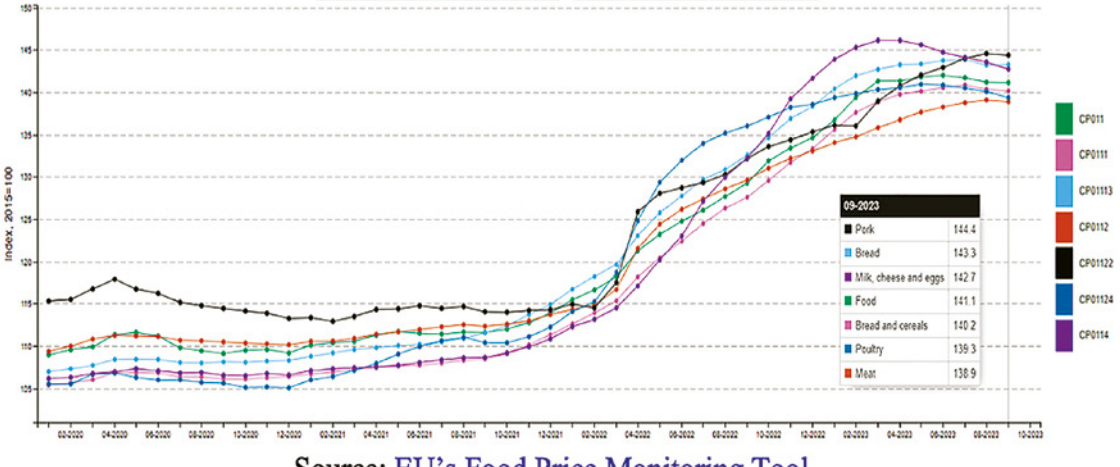
According to the **Foreign Agricultural Service**, total EU grain production for MY 2023/24 is estimated at 269 MMT, above MY 2022/23 levels but down from the 292 MMT registered in MY 2021/22. The EU experienced extreme weather conditions ranging from a severe drought in Spain to abnormally warm and dry summer conditions in the EU's eastern grain production areas (Bulgaria and Romania), as well as cooler temperatures combined with summer precipitation in large grain producing Member States such as France, Germany, or Poland. This ultimately resulted in a 1 MMT downwards revision in the total EU grain

output compared to Post's summer estimate.

Post has revised down the EU's total grain consumption for MY 2023/24 to 155 MMT. Swine and cattle farmers are reducing animal inventories as they face shrinking production margins, increasing regulatory Swine and cattle hurdles, and animal health issues. Likewise, EU dairy cow numbers are falling in line with the lower milk production profitability. Hof farms continue being affected by African Swine Fever (ASF) and Procine Reproductive and Respiratory Syndrome (PRRS) outbreaks. Bluetongue and emerging Epizootic Hemorrhagic Disease (EHD) cases are also negatively affecting ruminant feed demand, especially in southern EU Member States. In the Netherlands and Belgium, stringent environmental regulations are also responsible for lower animal production. On a positive note, despite the export limitations that the Highly Pathogenic Avian Influenza (HPAI) outbreaks pose to EU poultry production, the EU's poultry meat by inflation-hit price-sensitive EU consumers and the surge in tourism-driven HRI activity support the increase.

Food, Seed, and Industrial (FSI) uses in MY 2023/24 have been revised further up from MY 2022/23 as demand for grain-based industrial products such as starch, maltodextrin, glucose, ethanol3 gluten continues to grow driven by mainly the expanded use of installed processing capacity in Hungary, DDGS and and Bulgaria. Within FSI uses, the higher industrial use compensates the reduction expected in food uses in MY 2023/24, as EU price-sensitive consumers are cutting their expenditure in food in response to the high grain-based food items price levels prevailing (See Fig. 1).

Graph 1. EU Harmonized Index of Consumer Prices



Source: EU's Food Price Monitoring Tool.

Fungal disease driven by climate change endangers wheat production

Climate change poses a threat to yields and food security worldwide, with plant diseases as one of the main risks. A team of researchers from the Technical University of Munich (TUM) has shown that further spread of the fungal disease wheat blast could reduce global it production by 13% through 2050 (the study was published in *Nature Climate Change*).

With a global cultivation area of 222 million hectares and a harvest volume of 779 million tons, wheat is an essential food crop. Like all plant species, it is also struggling with diseases that are spreading more rapidly compared to a few years ago because of climate change, as wheat blast.

In warm and humid regions, the fungus *Magnaporthe oryzae* has become a serious threat to wheat production since it was first observed in 1985. It initially spread from Brazil to neighboring countries. The first cases outside of South America occurred in Bangladesh in 2016 and in Zambia in 2018. Researchers from Germany, Mexico, Bangladesh, the U.S. and Brazil have now modeled for the first time how wheat blast will spread in the future.

In Africa and South America up to 75% of the total wheat cultivation area is at risk

According to the researchers, South America, southern Africa and Asia will be the regions most affected by the future spread of the disease. Up to 75% of the area under wheat cultivation in Africa and South America could be at risk in the future.
According to the predictions, wheat blast will also continue to spread in countries that were previously only slightly impacted, including Argentina, Zambia and Bangladesh. The fungus is also penetrating countries that were previously untouched, as Uruguay, Central America, the south-eastern U.S., East Africa, India and eastern Australia.
According to the model, the risk is low in Europe and East Asia–with the exception of Italy, southern France, Spain and the warm and humid regions of south-east China. Conversely, where climate change leads to drier conditions with more frequent periods of heat above 35°C, the risk of wheat blast may also decrease. However, in these cases, heat stress decreases the yield potential.

Yield losses call for adapted management

The affected regions are among the areas most impacted by the direct consequences of climate change. Food insecurity is already a significant challenge in these areas and the demand for wheat continues to rise, especially in urban areas. In many regions, farmers will have to switch to more robust crops to avoid crop failures and financial losses.

In the Midwest of Brazil, for example, wheat is increasingly being replaced by maize. Another important strategy against future yield losses is breeding resistant wheat varieties. CIMMYT in collaboration with National Agricultural Research Systems (NARs) partners have released several wheat blast-resistant varieties which have been helpful in mitigating the effect of wheat blast.
With the right sowing date, wheat blast-promoting conditions can be avoided during the ear emergence phase. Combined with other measures, this has proven to be successful. In more specific terms, this means avoiding early sowing in central Brazil and late sowing in Bangladesh.

First study on yield losses due to wheat blast

Previous studies on yield changes due to climate change mainly considered the direct effects of climate change such as rising temperatures, changing precipitation patterns and increased CO2 emissions in the atmosphere.
For the study, the researchers focused on the influence of wheat blast on production by combining a simulation model for wheat growth and yield with a newly developed wheat blast model. Environmental conditions such as the weather are thus included in the calculations, as is data on plant growth.
In this way, the scientists are modeling the disease pressure in the particularly sensitive phase when the ear matures. The study focused on the influence of wheat blast on production. Other consequences of climate change could further reduce yields.

Food waste for silage production

In a research by the Department of Soil, Plants and Food Sciences, University of Bari, Italy, published in *Agronomy*, two experiments were conducted to investigate the chemical and fermentative characteristics of by-product-mixed silages consisting of wheat straw (WS), grape pomace (GP), olive mill wastewater (OMWW) and cheese whey (CW) at 7, 30 and 90 days.

The silage formulations were based on a ratio of 60% solids (WS + GP) and 40% liquids (CW + OMWW), with the addition of water (W) where necessary to achieve 40% of liquids. In experiment 1, the effects of the inclusion of GP or CW in a mixture of WS and OMWW were studied according to two silage formulations: SIL-A, WS40% + OMWW5% + GP20% + W35%; SIL-B, WS60% + OMWW5% + CW35%. In experiment 2, the effects of two levels of CW and the inclusion of OMWW in mixed silages based on WS, GP, and CW were studied according to four silage formulations: SIL-C, WS40% + GP20% + CW20% + W20%; SIL-D, WS40% + GP20% + CW20% + OMWW5% + W15%; SIL-E, WS40% + GP20% + CW35% + W5%; SIL-F, WS40% + GP20% + CW35% + OMWW5%. In experiment 1, the silage formulation affected the chemical composition showing a greater ($p<0.05$) content of DM in SIL-B; crude protein, ether extract and ADL contents were higher ($p<0.05$) in SIL-A. In experiment 2, no differences ($p>0.05$) in the chemical characteristics of the silages were found. In both of the experiments, the

chemical composition and total phenol content did not change (p>0.05) during the ensiling period. Fermentative characteristics were not affected (p>0.05) by the by-product combination nor the ensiling period and proved to be adequate for good-quality silages. The Flieg's scores at D30 and D90 were greater than a 100 score in all the experimental silages, leading to the conclusion that WS, GP, OMWW and CW can be effective for producing silage.

Gene editing improves flowering time and salt tolerance of maize

A Chinese study published in *Plant Biotechnology Journal* shows that the knockout of ZmPRR37-CR resulted in the early flowering of maize, founding that the ZmPRR37 gene can potentially enhance salt stress tolerance in maize.

Flowering is a crucial stage in plant reproductive development. However, it can be affected by various environmental factors, which can either delay or accelerate the flowering of plants. As a short-day plant, flowering of maize in long-day environments has been challenging. Hence, the researchers analyzed and edited the genes of maize to induce flowering and improve salt tolerance.

The study revealed that the ZmPRR37 gene causes delays in the flowering of maize under long-day conditions. The findings provide significant insights into the crucial role of ZmPRR37 in regulating flowering time and salt stress response in maize.

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Future trends in organic flour milling

The use of artificial intelligence techniques offers solutions and new perspectives to meet the different objectives of the miller. A review was conducted in Canada, with an article published in *AIMS Agriculture and Food*, of artificial intelligence techniques developed at each stage of the value chain surrounding the issues of quality and yield is conducted. An analysis of a large number of variables, including process factors, process parameters and wheat grain quality from data collected on the value chain enables the development and training of artificial intelligence models. From these models, it is possible to develop decision support tools and optimize the wheat flour milling process. Several major research directions, other than constant quality, are to be studied to optimize the process and move towards a smart mill. This includes energy savings, resource optimization and mill performance.

The functionality of macromolecules of oat milling fractions

The aim of a Hungarian work appearing in *Food Hydrocolloids* was to investigate the role of oat constituents in rheological (mixing and pasting) properties and baking performance. To accomplish this, oat milling fractions with different particle size and dietary fibre contents were produced and analysed.

The results showed that, with increasing flour particle size, in addition to fibre components, the level of proteins and lipids increased as well, while the digestible carbohydrate content decreased. There were changes also within the fine composition of macro components such as proteins (based on SDS-PAGE), starch (amylose to amylopectin ratio) and beta-glucans (molecular weight distribution). With increasing fibre content, dough matrices were characterised by higher water absorption, longer development time, and lower softening, while flour slurries formed more viscous gels. Regarding baking properties of oat milling fractions, it was found that higher fibre content resulted in better crumb structure, supported by images of cross-sections and texture profile analysis. In addition, higher amylose to amylopectin ratio might have contributed to the formation of less resilient crumb structure. Correlation analysis between baking performance and rheological properties showed that doughs with higher water content and lower softening degree, as well as slurries with higher viscosity values resulted in better crumb structure.

In conclusion, high-fibre oat milling fractions were found suitable to produce breads with acceptable quality traits. The work might also contribute to expand the knowledge about the functionality of oat constituents and to develop new, fibre-rich oat-based products supporting the consumption of more dietary fibre.

Study on the water flows of the mills

Millstreams vary in quality due to the heterogeneous spatial distribution of biochemical components in the wheat kernel. The aim of an American research published in *Cereal Chemistry* was to investigate variations of protein parameters characterized using size-exclusion high-performance liquid chromatography (HPLC) coupled with multiangle light scattering (SE-HPLC-MALS) and their correlations with bread-making quality in various millstreams obtained from long-flow experimental milling of hard red spring (HRS) wheat. Quantitative variations for proteins, especially storage proteins such as gliadins and glutenin polymers, were primarily correlated with bread-making quality in millstreams. Compositionally, a nonstorage protein fraction percentage was identified to be a complemental explanatory variable for prediction of bread loaf volume showing coefficient of determination of 0.936 in multiple regression with protein content. The molecular weight (MW) values of polymeric protein fractions determined by MALS varied significantly among millstreams showing negative correlations with bread quality traits.

The protein SE-HPLC-MALS parameters were effective for the evaluation of millstreams as demonstrated by significant correlations with bread-making traits.

Novel information was reported on the variation of protein MW characteristics analyzed by SE-HPLC-MALS in relation to end-product quality for HRS wheat long-flow millstreams.

Support tool for the first stage of the tempering process of wheat

Wheat tempering conditions grains before a milling process begins. Process adjustments must be made to reach a desired level of flour quality and yield, depending on multiple factors.

A Canadian article published in *International Journal of Food Science & Technology* aims to develop a decision support tool to help operators adjust the first-stage tempering parameters. It is based on a regression model that predicts an increase in organic wheat moisture content according to the properties of the wheat (initial wheat moisture content, wheat protein content and wheat temperature), process parameters (targeted wheat moisture content, wheat flow rate, water flow rate, wheat quantity and resting time) and tempering conditions (water quantity, average day temperature and average day humidity). The increase in wheat moisture achieved during the first tempering stage varies between 0% and 5%. Five regression models were compared: OLS, LASSO, RIDGE, ElasticNet and XGBoost. The models have been developed and tested from a case study at an organic wheat mill.

The results indicate that the LASSO model outperformed others, with an average prediction error of 0.428%. The model showed the importance of humidity and temperature factors during the tempering process. The flow of water and wheat were the most influential parameters for an increase in wheat moisture content.

Phage biocontrol reduces contamination of wheat with *Escherichia coli*

Contamination of wheat flours with Shiga toxin-producing *E. coli* (STEC) is a concern for the milling industry. Milling-specific interventions are needed to address this food safety hazard.

The objectives of an American study published in *Journal of Food Protection* were to determine the efficacy of bacteriophage treatment in reducing wheat STEC contamination during tempering, and assess its effects on flour milling and baking quality. Bacteriophage solutions were prepared by mixing sterile water with the bacteriophage treatment at the following levels: 1 × 106 (0.1%), 2.5 × 106 (0.25%), 5 × 106 (0.5%), 1 × 107 (1.0%), and 1 × 108 (10%) PFU/g wheat dosage. Sterile water (0%) was used as the control. Predried wheat grains were inoculated with STEC (O121 and O26) at 5.0 and 6.0 log CFU/g to restore its original moisture content followed by resting for 24 h. Inoculated grains were then tempered (16% moisture, 24 h) using the prepared bacteriophage solutions. Grains were sampled at 0.5, 1, 2, 6, 12, 18, and 24 h during tempering to determine STEC concentration. The effects of the phage solutions on the flour milling and baking quality were also tested. Tempering time, bacteriophage dose, and their interaction had significant effects on phage efficacy ($P<0.05$), with better reductions observed at longer tempering times and higher bacteriophage doses. The use of phage solutions reduced ($P<0.05$) wheat STEC concentration after tempering, with the 10% treatment (3.2 logs) achieving ahigher reduction than the 1% (2.4 logs) treatment under similar phage preparation. Phage tempering (including at the highest concentration examined, i.e., 10%) produced wheat flours with comparable quality to the control. Phage-treated wheat flour resulted in breads with finer crumb structure, and comparable texture compared to the control.

Phage tempering is a viable intervention for wheat milling as it reduced STEC loads of wheat with no detrimental effects to flour milling and baking quality.

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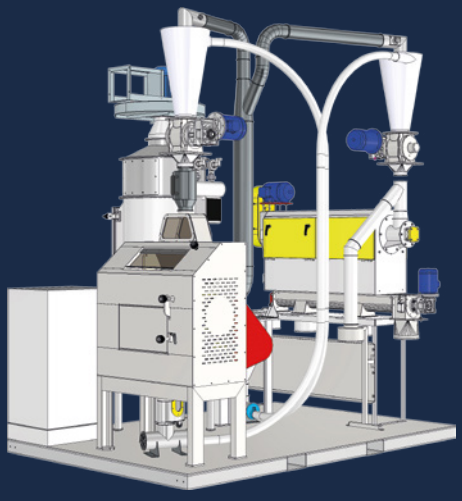

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In vitro starch digestion and glycemic index

Gluten-containing (GC) and gluten-free (GF) pasta consumption has been growing in recent years. The market offers a wide variety of types, with differences in shape and formulation that influence the mastication process and, consequently, their nutritional behaviors (i.e. starch digestibility and glycemic response).

Research by the School of Biosciences and Veterinary Medicine, University of Camerino (Mc - Italy), published in *Food & Function*, investigated the effect of shape, gluten, and structural breakdown on *in vitro* starch digestibility and predicted the glycemic index (pGI) of GC and GF penne, spaghetti, and risoni. Pasta was cooked and minced to mimic short, intermediate, and long mastication efforts. Short mastication led to a higher number of big particles than intermediate and long masticications for all pasta samples, which was reflected in the different starch digestibility and pGI patterns. Multivariate analysis of variance showed that the three studied factors differently affected the *in vitro* starch digestion of pasta. Mastication effort, shape, and their interaction mainly affected the starch digestion rate and pGI. Gluten was the major factor in affecting the amount of digested starch.

The results suggested that small shapes (i.e. risoni), the presence of gluten, and short mastication effort led to a lower pGI.

Effect of heat-moisture treatment of wheat grain

The effects of heat-moisture treatment (HMT) of wheat grain on the contents of vitamins and minerals in wheat flour were analyzed to explore the functions of HMT of wheat grain in enhancing the micronutrient content of its flour. In addition, the gelatinization and thermomechanical properties of wheat flour and qualities of noodles and bread were studied.

The results of a Chinese research published in *Journal of Cereal Science* demonstrated that HMT of wheat grain at 65°, 80°, and 95°C could significantly improve the contents of vitamins or minerals in wheat flour. HMT at 95°C resulted in a slight gelatinization of wheat starch and weakening of gluten; however, at 50° and 65°C, dough stability improved. HMT at 50° and 65°C improved the qualities of noodles and bread, whereas they worsened at 95°C. Therefore, HMT at 65° and 80°C can improve the content of vitamins and minerals without significantly effecting noodles and bread qualities.

Consumer preferences for spirulina-enriched pasta

The increasing interest in functional foods has led to research into nutraceutical sources, which has resulted in the discovery of microalgae, particularly spirulina, as a promising option. Spirulina is unique for its high protein content, essential amino acids, and rich mineral and vitamin content. Additionally, spirulina cultivation is environmentally friendly as it requires only a small area and has minimal emissions. However, despite the significant potential of spirulina-based products, their market penetration remains low due to investment costs. Therefore, assessing market interest and consumer preferences is crucial for promoting development. To understand consumer interest in spirulina-based products, researchers from the Department of Agricultural, Food, Environmental and Forestry Sciences and Technologies of the University of Florence conducted a study, which appeared in *Algal Research*, using a representative sample of 326 Italians who participated in a choice experiment involving a pack of pasta that could be spirulina-enriched or not.

The results indicate that there is a substantial consumer segment interested in spirulina-based pasta and willing to pay an average premium of €1.28 for a 1-kg package. This segment comprises prevalently young, physically active, well-educated men, who are interested in healthy eating and open to trying new foods. They primarily have a plant-based diet and good familiarity with functional foods.

Diverging fates for cadmium and glyphosate

Durum wheat cultivars with varying abilities to accumulate cadmium were grown and treated in the field with a glyphosate-containing herbicide at different stages of maturity to produce grain with higher and lower concentrations of cadmium (0.066-0.214mg/kg) and glyphosate (0.474-0.874mg/kg). The highest concentrations for both cadmium and glyphosate were associated with bran and shorts, although the percentage of total cadmium mass in bran (23-25%) was less than glyphosate (38%). The preparation of dried pasta from semolina and flour milling fractions reduced concentrations by a factor of 1.8 for glyphosate and 1.4 for cadmium. Dried pasta was cooked and analysed along with the cooking water for cadmium and glyphosate at seven-time points from 0 to 15min. Concentrations of glyphosate in cooked pasta decreased significantly with cooking time; no decrease was observed for cadmium concentrations. Analysis of cooking water demonstrated that glyphosate migrated from pasta to the cooking water. After 15min of cooking, approximately 73% of the total glyphosate mass had transferred from pasta to cooking water. Over the same time period, only 5% of the total cadmium mass had transferred from pasta to cooking water.

The research was conducted by Canadian researchers, published in *Food Additives & Contaminants* journal.

The value of lupine

Nutritionists have recommended an increased consumption of dietary fiber in the daily diet to improve health. Within this context, in *Journal of Food Science*, Tunisian researchers have published a work that proposes to formulate "spaghetti" pasta enriched with lupin flour and wheat bran. For the formulation of the mixture of those flours, we used the NemrodW software to predict the optimal pasta formula.

A physicochemical characterization, as well as the culinary quality of the pasta resulting from the different mixtures, was carried out to model each significant criterion and choose the optimal mixture that will be used in the pasta recipe. The evaluation of the physicochemical characteristics of the pasta showed that the addition of lupin flour and bran resulted in an improvement in the nutritional value of the enriched spaghetti. Following the results obtained, the software proposed an optimal mix and will be used for further study. This formula comprises 19.60% bran, 27.83% lupin flour, and 52.75% durum wheat semolina. The caloric value of the dough from the optimal mix was determined and compared to that of the standard dough.

The results indicated a improvement in the nutritional value of the enriched pasta compared to the standard pasta. The enriched pasta contained higher levels of protein, ash, lipids, polyphenols, and pigments and lower levels of sugars, which make it a more nutritious option for certain individuals, such as athletes or those following a protein or low-sugar diet.

Pasta fortified with beta-glucan isolated from brewer's yeast by-product

Beta-glucan from brewer's spent yeast is a novel ingredient approved to be included in the human diet.

A Romanian article published in *Journal of Cereal Science* evaluated the effects of beta-glucan extracted from spent brewer's yeast on the physico-chemical, rheological, textural, microstructure, and molecular characteristics of common and durum wheat pasta, at different addition levels. The results showed a decrease in dough viscous and elastic moduli, while the resistance to deformation and hardness raised as the addition level increased. Pasta quality parameters were influenced by the beta-glucan content depending on the wheat type, with lower pasta firmness (2.76 and 3.40 N for common and durum controls *vs.* 2.76-1.97 and 3.35-2.73 N for common and durum enriched pasta respectively), increased carbohydrate content (from 85.63% to 85.91-86.95% in common wheat pasta, and from 81.89 to 82.12-82.28% in durum pasta), cooking loss (from 4.73% in common control to 4.91% for 4% common wheat-beta-glucan pasta, and from 3.68 in durum control to 5.05% for 4% durum wheat-beta-glucan), and darker color being obtained. Pasta microstructure and molecular FT-IR characteristics confirmed the presence of beta-glucan in cooked pasta and depicted protein denaturation and contribution to the final product matrix.

The results represent new insights into the development of convenient matrices for functional ingredient incorporation.

Volatile fatty acids production from waste

The 31% of the global production of pasta is made by Italian companies: here, about 120 companies assure an annual production of 5.3 million tons of pasta. The pasta not compliant with the required selling standards (for example size, weight) is usually crushed, grounded to power, and used for animals feeding.

A study by the Department of Biotechnology of the University of Verona, published in *Biochemical Engineering Journal* offered a more advantageous alternative for the valorization of pasta by-products, whose mono-fermentation for Volatile Fatty Acids (VFAs) production was not investigated before. In particular, were considered pasta residues to optimize the operational parameters both in batch and in continuous conditions. The first round consisted in batch tests at different Total Solids (TS) concentration (1.5-10% TS w/w). The 2% TS w/w emerged as the best one, able to assure a VFAs yield close to the 80%. Consequently, this concentration was chosen for the conduction of continuous tests dedicated to the optimization of the best HRT and SRT for the process. The HRT of 3 d and a SRT of 4.4 d allowed the best process performances with a VFAs productivity of 3.48 $g_{VFAs\_}$ COD per L of reactor and per day. The optimization of the process conditions for VFAs production led to a greater concentration of butyric acids (about 10% w/w) instead of the mere acetic acid production. Because of the economic value of butyric acid, this result is of particular interest.

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Tailor-made fermentation of sourdough reduces the acrylamide content

In a work carried out by researchers from the Faculty of Agricultural, Environmental and Food Sciences of the Free University of Bolzano, Italy, and published in *International Journal of Food Microbiology*, 30 strains of lactic acid bacteria (LAB) and Saccharomyces cerevisiae E8.9 (wild type) were used to formulate 15 combinations of starters by mixing two or three LAB with the yeast (ratio LAB: yeast, 10: 1).

Such combinations were used to prepare rye sourdough and their performance in term of acidification and biochemical characteristics during fermentation at two temperatures (30° and 37°C) and duration (4 and 8 h) were screened. The best 13 sourdough formulations were selected and used for rye crispbread making. The analysis of acrylamide concentration demonstrated that 11 out 13 formulations resulted in significant decreases of concentration compared to the baker's yeast (control), with reductions up to 79.6%. The rye sourdough crispbreads showed also higher amount of volatile organic compounds (VOCs) compared to the baker's yeast control. Two rye sourdough crispbreads, selected to represent the opposite extremes within the 13 formulations in term of VOC profiles and fer-

mentation performances, demonstrated better sensory and nutritional features, such as phytic acid reduction (up to 47.3 %), and enhanced total free amino acid compared to the control.

These evidences suggest the potential of tailored sourdough fermentations as alternative and suitable biotechnological strategy for lowering acrylamide levels in rye crispbread.

The volume of bread in various climatic conditions

Climate change is causing increased periods of drought stress and higher temperatures which are affecting wheat quality. Alveograph extensibility is important for durum wheat loaf volume (LFV), as is the relationship between dough tenacity and extensibility.

A study (published in *Journal of Cereal Science*) was conducted in South Africa to identify the factors determining LFV and alveograph properties under optimal and stress conditions. Six durum wheat cultivars with the same glutenin composition were grown for two seasons under optimal, drought and heat stress conditions. Good LFV was consistently related with higher dough extensibility, irrespective of production conditions. A number of the LMW glutenin fractions, and the gamma-gliadins were reduced and beta-gliadins were increased under both heat and drought stress. The large and total unextractable polymeric proteins and unextractable HMW glutenins were reduced by heat stress. In a multiple regression of LFV (without alveograph values), solvent retention capacity and sodium dodecyl sulphate sedimentation were the best predictors of LFV under all conditions. Size-exclusion high-performance liquid chromatography fractions combined with flour protein content were good predictors of LFV only under optimal conditions.

The pluses of sprouted wheat

An Irish work appeared in the *Journal of Cereal Science*, in which the effect of whole wheat flour partially replaced by sprouted whole wheat flour on phenolic profile, dough rheological properties and bread characteristics, was studied. A 3x3 factorial design was used to evaluate three sprouting times (24, 48 and 72 h) and three replacement percentages (5, 15 and 25%) compared to the control sample (whole wheat flour). Total amylolytic activity (+43%), alpha-amylase (+73%) and antioxidant activity (+3.8 times higher) of flours progressively increased with sprouting times. However, it did not change the total phenolic content. The progressive increase of sprouting time and replacement levels can negatively impact the dough and bread-making due to a weakened gluten network and reduced dough strength caused by the increased enzymatic action. Moreover, bread firmness and chewiness were increased. Eighty-eight phenolic compounds were annotated by metabolomics tools. Phenolic acids had the highest ion abundance due to the isomers of ferulic acid. Principal Components Analysis showed great variability of phenolic compounds abundance in sprouting time (99%) and replaced flours (87%).

The results suggest that sprouted wheat flours can be incorporated into baked products, although improving the bread characteristics is dependent on the sprouting time and its replacement levels.

Influence of milling technique

A number of studies have shown the effect of cereals and sourdough on bread nutritional and organoleptic quality, but the impact of the milling technique remains little studied. There are two main types of milling technic depending on the bread-making food chain. Industrial bakeries mainly use roller mills while artisanal bakeries may also use stone mill.

French researchers organized a participatory experiment with six millers and four bakers to study the impact of these two milling techniques on the quality of flours, sourdough microbiota and the quality of breads (the full study appeared in *Food Microbiology* journal). Millers made 22 flours from 4 different wheat grain varieties using either roller or stone mills. Each baker initiated and maintained sourdoughs with three roller-milled and three stone-milled flours during at least 32 backsloppings and then made bread. The analysis of flours revealed a typical granulometry profile linked to wheat hardness with higher particle sizes for stone-milled flours. Stone-milled flours also had a higher maltose content. However, the milling technic did not drive the composition of the sourdough microbiota. Moreover, the analysis of bread revealed that variation in bread protein fractions and in bread aroma compounds were more related to the specific baker microbial community than to the milling technique. Carbohydrate contents were clearly linked to the main LAB species metabolism.

The results revealed that the sourdough microbial community shapes the organoleptic and nutritional quality of bread more than milling techniques.

Improvement of the antioxidant value of sourdough bread

A work by the Department of Biological, Chemical and Pharmaceutical Sciences and Technologies, University of Palermo has been published in *Innovative Food Science and Emerging Technologies*, in which the suitability of waste from cold pressing of Rubus ideaus seeds (WRSP) as functional ingredient in bread. Fortified bread was produced replacing wheat flour/semolina mixture with 5% or 10% WRSP. WRSP did not affect sourdough lactic acid bacteria starters development since their cell densities reached levels around 108CFU/g at the end of fermentation. Illumina data showed the dominance of lactobacilli in the obtained doughs (82.08-88.76% of relative abundance). Concerning functional properties, the results indicated that WRSP inclusion increases the content of polyphenolic compounds, particularly proanthocyanins, and the antioxidant activity of both functionalized doughs and final breads. Specifically, the substitution of 5% or 10% of the flour/semolina mixture with WRSP, as compared to the control dough, resulted in a two- to threefold increase in the total polyphenolic content and in a three- to fourfold increase in metal-reducing potential. Finally, compared to the control bread, breads enriched with WRSP exhibited enhanced redness in both the crust and crumb, and in terms of sensory qualities, they obtained higher appreciation from evaluators.

Effects of microbial transglutaminase on gluten-free bread

Researchers from US published in *Journal of Cereal Science*, a work in which they studied the effects effects of microbial transglutaminase (mTG) on structure and loaf properties of gluten-free (GF) sourdough breads containing five different flours: chickpea, brown rice, white rice, oat, and quinoa.

SDS-PAGE analysis revealed that white rice, brown rice, quinoa, and chickpea proteins are adequate substrates for mTG activity, while oat proteins, without the addition of exogenous proteins, lack the characteristics suitable for mTG action. Additionally, mTG engages in self-crosslinking. The utilization of mTG in GF sourdough bread applications was shown to improve some of the final bread characteristics of GF breads. White rice- and brown rice-GF sourdough loaves at 24 h showed a 28% and 13% decrease in crumb firmness with the addition of 2 Units mTG per gram (U/g) of dough. Quinoa-GF sourdough breads at 24 h showed a 6% increase in specific volume with the addition of 1 U/g. Oat- and chickpea-GF sourdough loaves did not show improvements in loaf quality with mTG addition.

Flours from microwave-treated buckwheat grains improve the gluten-free bread

A Spanish study appeared on *Food Hydrocolloids* in which the microwave (MW)-assisted hydrothermal treatment of buckwheat grains was explored to improve the physical properties and nutritional quality of gluten-free (GF) bread.
A mixture of 80% rice flour and 20% corn starch was used as control recipe (CR), whereas for fortification, 50% of the rice flour was replaced with native buckwheat flour (BN) or buckwheat flour from grains treated with several MW cycles (exposure/rest cycles of 10/50 s, BT1, 20/40 s, BT2, or 30/30 s, BT3, at 30% moisture content and 8 min MW exposure). The BN fortified dough showed increased consistency and elastic response, compared to CR, with the MW treatment further enhancing these effects. Due to the enormous increase in complex modulus (G1*) (from 1060 Pa for CR to 10,679 Pa for BT3), the hydration of doughs was subsequently adjusted to obtain similar G1*. The inclusion of MW-treated flours led to higher consistency and elastic recovery. The lower specific volume (SV) and higher crumb hardness encountered for BN (3.88 mL/g and 1.45 N) were alleviated by the inclusion of MW-treated flours (4.61 mL/g and 0.90 N for BT1, 4.39 mL/g and 0.85 N for BT3), resulting in similar SV and lower staling than CR. Moreover, compared to BN and CR, the BT2 and BT3 breads showed a reduction in glucose release during in vitro starch digestion (up to -25%), and an increase in protein digestibility (up to +23%).
Overall, the experimental findings pointed to the feasibility of using MW to improve the physical and nutritional quality of buckwheat flour-enriched GF bread.

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Mitigating the environmental impacts from pig and chicken productions

The rapid expansion of the livestock production sector to meet the world population's demand is posing a big challenge to environmental sustainability. Plant-based feed additives extracted from agro-food byproducts could potentially result in multiple outcomes: reducing food-processing wastes and improving animal growth performances, hence mitigating environmental impacts of meat production chains.

A French study published in *Animals* journal was conducted to assess the environmental impacts of the use of a commercial citrus extract feed additive (CEFA) in swine and broiler chicken farming. Life-cycle assessment (LCA) was applied to assess the impact of manufacturing and distributing one 25 kg bag of CEFA and its use in feed in broiler chicken and swine productions. With regards to CEFA manufacturing and distribution, results showed that most of the impact came from the production of CEFA ingredients, accounting for 70% of the impact generated. The remaining 30% effect was divided between transportation to the customer (25%), CEFA packaging (3%), and CEFA manufacturing and production loss (2%). When enlarging the scope, the use of the CEFA in pigs and broilers' diets was shown to improve the measured environmental indicators, compared to such standard systems. Indeed, CEFA-added feeds have demonstrated enhanced growth performances, hence reducing the required amount of consumed feed to achieve the same level of growth. Consequently, this helped reduce environmental issues from animal feed ingredients' agriculture. To be more specific, the use of one 25 kg bag of CE-

FA in feed at 250 g per ton of feed led to a reduction of 6 tons of CO2 equivalent (CO2 eq) emitted along the life cycle of poultry production and 5 tons in the case of fattening pigs. The inclusion of this CEFA in the diet also led to a reduction in the land use footprint by 0.7 hectares and reductions in water consumption by 201 m^3 and 82 m^3 for broiler chicken and swine production. The environmental performance assessment thus showed the interest in using this CEFA in swine and broiler chicken diets to mitigate the environmental impacts.

Influences of flavonoid inclusion to corn-soybean-gluten meal-based diet on broiler

A study presented in the *Journal of Animal Physiology and Animal Nutrition* was conducted by researchers from South Korea to evaluate the impact of graded doses of quercetin (QS) on growth efficiency, nutrient retention, faecal score, footpad lesion score, tibia ash and meat quality.
In a 32-day feeding test, a total of 576 1-day-old Ross 308 broilers (male) were allocated arbitrarily with an average body weight of 41+/-0.5g. The trial had 4 dietary treatments with 8 repetitions of 18 birds per pen and a basal diet incorporating 0, 0.02, 0.04 and 0.06% of QS. As the QS dosage increased, body weight gain tended to increase linearly on Days 9-21 (p=0.069) and overall period (p=0.079). Similarly, feed intake increased (p=0.009) linearly with the increasing doses of QS on Days 9-21. There was a improvement in dry matter (p=0.002) and energy (p=0.016) digestibility after QS administration. Moreover, the inclusion of QS supplement (0%-0.06%) increased (p=0.012) tibia ash in broilers. However, the faecal score and footpad lesion score showed no significant outcome (p>0.05). By giving broilers a graded amount of QS, the relative organ weights of breast muscle (p=0.009) and spleen (p=0.006) improved, meat colour lightness increased (p=0.015), redness tended to improve (p=0.065) and drip loss decreased (p=0.015).
The inclusion of QS in the graded-level diet led to improvements in growth efficiency, nutrient absorption, meat quality and tibia ash, which recommended it as a beneficial feed additive for the broiler.

GMO feed on the diet of laying hens

A study, which appeared in the *Brazilian Journal of Poultry Science*, was conducted in South Korea to examine the effect of feeding genetically modified organisms (GMO) compared with non - GMO diet on performance of layers in terms of egg production, egg broken rate and egg quality in laying hen. One hundred and ninety-two Hy-line brown laying hens were used in the feeding for four weeks. All the birds were randomly assigned into two dietary treatments groups, each with eight replicates (12 hens/ replicate). Significant difference was not found in egg production in layers fed GMO feed in diet compared with the non - GMO treatment. Whereas in terms of egg quality, a significant increase was observed in yolk color and eggshell thickness of layers fed GMO diet compared with layers fed non-GMO diet at 1st week. Additionally, there was a significant increase in eggshell thickness of layers fed GMO diet compared with layers fed non - GMO diet at 2nd, and 4th week. Layers fed GMO diet showed higher egg yolk value compared to the non-GMO diet in 1st week. However, no significant differences were found in other profiles such as egg quality including egg weight, albumen height, haugh units, shell color, and shell strength from 1st to 4th week since layers fed GMO.

Maize silage with citrus pulp

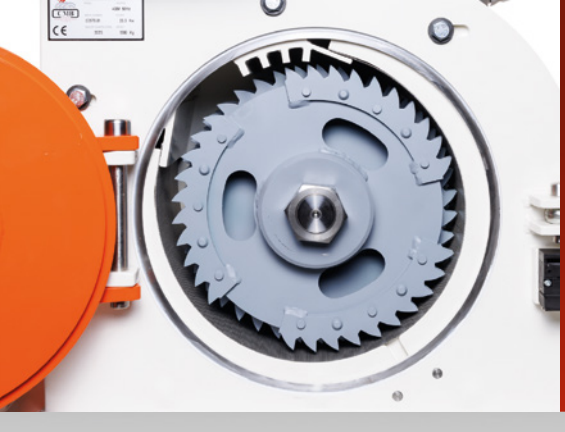
The objective of a Brazilian study published in *Brazilian Journal of Animal Health and Production* was to evaluate the effects of including citrus pulp in maize silage on chemical composition and fermentation parameters. The experimental design was fully randomized with four replicates. Maize silage consisting of 0-50% citrus pulp was produced and analyzed. The pH linearly decreased with the increased inclusion of citrus pulp (3.49 at 50% citrus pulp), which is far below what is considered adequate (3.8-4.2). However, not all fermentation parameters were compromised. At 33% citrus pulp, we estimated 30.82 g/kg total nitrogen. At 49% citrus pulp, 95.16 g/kg of crude protein was estimated. At 21% and 22% citrus pulp, 549.89 g/kg of neutral detergent fiber and 678.11 g/kg of total digestible nutrients have been estimated.

Therefore, the inclusion of up to 30% citrus pulp improves the complete chemical composition of maize silage owing to the reduction in structural carbohydrate values and increases in total digestible nutrient and protein content.

The type of grain affects the growth performance and meat quality of pigs

In a Polish research published in *Animals*, the effect of high level of barley, triticale, or rye as base of complete mixtures for growing-finishing pigs on growth performance, carcass traits, meat quality, and fatty acid profile in meat and backfat was investigated.

The 100-day experiment involved 72 pigs, assigned into three groups (24 animals each). Pigs of each group were kept in six pens (two gilts and two barrows per pen). Diets offered to pigs differed in the proportion of cereals as the leading ingredients in the mixture formulation: I-barley, II-triticale, III-rye. The results showed diversified grain influence on the production results and meat quality. Triticale- and barley-based diets ensured better weight gain and lower carcass fatness than rye ($p<=0.05$). The basic nutrients digestibility of mixtures containing triticale was comparable to that containing barley and higher than that of rye ($p<=0.05$). The meat and backfat of pigs receiving diet with triticale or barley was characterized by more favorable fatty acids profile in respect to the health-promoting indicators (atherogenicity and thrombogenicity indexes; hypocholesterolemic/hypercholesterolemic ratio). The cholesterol level in various tissues was the lowest in pigs fed with rye diet, and their meat characterized by better water holding capacity and more SFA. Higher fat saturation indicate better resistance to oxidation during storage and longer meat shelf life. It seems that the supplementation of triticale to diet may improve the growth efficiency of pigs and the health-promoting value of meat, while the supplementation of rye may be better for the production of traditional or long-matured meat products.



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Cusinato Giovanni celebrates its 60th anniversary

February 23rd was a special day for **Cusinato Giovanni**: in a splendid 18th century Venetian villa in Bassano del Grappa, Italy, the 60th company anniversary of an amazing journey that began back in 1964, was celebrated together with all the employees, customers, agents, suppliers and friends.
With over 23,000 machines and 2,600 silos installed the company has become a leader in the production of high quality plants dedicated to the handling and

Villa Rezzonico - Bassano del Grappa (Vi - Italy)

During Vanni Cusinato's speech, president of Cusinato Giovanni.

storage of food and non-food products, such as pasta, pet food, snacks, dried fruit, candies, pulses, seeds, flours, wood pellet, plastic granules... In 85 countries around the world, Cusinato handles more than 30% of the world's short cut pasta production every year.
Constant growth supported by many strategic choices in synergy with each other, such as the pursuit of the highest quality in its system, the diversification in application sectors, an international outlook on target markets and continuous investment in research and development.
The systems can connect to customers' ERP software to achieve total integration with the production planning, with the possibility of calculating the main performance indexes, guaranteeing complete traceability of products and performing remote assistance.
The anniversary event was also an opportunity to celebrate the 85th birthday of the founder **Giovanni**, an entrepreneur who made himself out of nothing, who has always believed in his own abilities and ideas, looking to the future with tenacity and foresight. Over the years, he has been able to pass on the company's values and mission to his children and a new, high-profile management team, who together now lead the company into the future.
(Cusinato Giovanni - Via Monte Pelmo 8 - 35018 San Martino di Lupari - PD - Italy - Tel. +39 049 9440146 - www.cusinato.com)

Pellicola's family presents the new group

Gruppo Pellicola was born in Altamura, Italy, from the Pellicola family's many years of experience in the engineering industry, enclosing several companies united by Italian manufacturing, customised design and constant investment in research and development.

Molitecnica Sud designs and manufactures milling and agri-food plants, 100% certified Made in Italy. The company proposes a rich package of services ranging from preliminary analysis to customized design. It was founded more than 50 years ago from the idea of Giuseppe Pellicola (Knight of Labour) to create unique solutions for the agri-food industry. Today the company is managed by his sons who carry on the same passion for the work as its founder, but with a more global vision: that of "spreading the Italian milling and food culture in the world'.

Technalia specialises in research and development and in the creation of agri-food, construction, energy plants and 24-hour shops. It operates with a business philosophy of commitment, research, reliability and continuous attention to technological evolution and global changes. An innovative company that ranks among the most reliable partners in Italy and worldwide. Its brand Automatic Solutions deals specifically with 24-hour shops and vending machine installations.

Gruppo Pellicola has a clear mission: develop and realize cutting-edge engineering solutions. Its strength lies in the

A milling plant by Molitecnica Sud.

The production plant of Gruppo Pellicola.

accurate specialisation in each sector, which allows it to be one-step ahead of the market, as well as offering the best quality available, customization, so that each client can receive the solution best suited to their needs, maximum professionalism in the various operating sectors and the ability to manage even complex projects.

The corporate culture rooted in a modern managerial approach, on continuous investment in human resources, represents a plus for the Group, which has in the "vision" the goal and aspirations that is "to improve everyday life through engineering". To improve in order to achieve ever more concrete benefits, to create mutual value between company and clients, to be an inspiration to give one's best. Through all the resources Gruppo Pellicola has at the disposal, including the network of partners (composed of the companies: **Anselmo Group**, **Dime Metal Design**, **Tarsia Consorzio** and **Virtus Ingegneria**), it aims to go beyond the concept of a company of excellence, to become a point of reference in various sectors over time.

Carlo Pellicola, CEO of Gruppo Pellicola, declares: "We are pleased to officially present Gruppo Pellicola, a project that has deep roots in our family's vision. We have long had the desire to combine the strengths of the companies to offer different metalworking solutions for different sectors. We are grateful for the continued support of the employees, customers and partners, and we are excited to share this new phase of our journey. There will soon be some important new developments that will allow us to achieve the goals and confirm us as a successful company".

(Gruppo Pellicola - S.P. per Ruvo di Puglia km 1,300 - C.da Torre La Macchia - 70022 Altamura - BA - Italy - Tel. +39 080 3101016 - www.gruppopellicola.it)

A comparative analysis of traditional refrigeration systems and spiral freezers

Spiral freezers are one of the most highly-talked-about innovations in the food and beverage industry. Their ability to freeze meat products, seafood, and packaged foods without altering their taste, smell, and quality in any way has led to the growth in their adoption in various food processing industries.

Why spiral freezers are better than traditional freezers

The increasing shift in food packaging and food processing industries from traditional freezers to spiral freezers is not without any substantial reason. Spiral refrigeration systems have certain conclusive advantages over traditional freezers which give them an edge over their counterparts.

The main concern with respect to traditional freezers is that their slow freezing tendency causes the formation of ice crystals in the cellular structure of food products which spoil the taste and quality of the food items.

Spiral refrigerators, on the other hand, allow for rapid freezing of food products, thus reducing the possibility of deterioration of food quality. Hence, packaged foods, which need to be preserved and transported, are generally stored in spiral refrigerators. Another important advantage of spiral refrigerators over traditional ones is that spiral refrigerators offer higher efficiency and throughput. A spiral refrigerator is designed in such a way that the conveyor belts in the machine make use of the energy efficiently and offer better and continuous freezing. This reduces the overall carbon footprint caused by refrigeration. A crucial consideration for small-scale businesses like local pizza restaurants is that they have a dearth of space for placing traditional refrigerators in their shops or hotels. Spiral refrigerators occupy much less space compared to traditional freezers and thus solve the dilemma faced by these businesses.

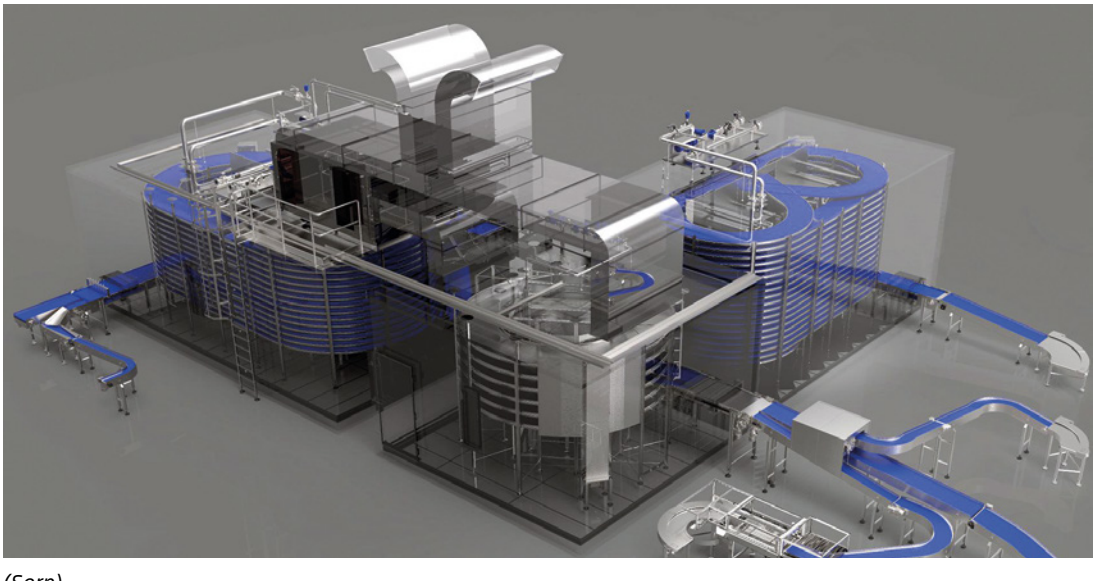
Factors helping the market to surge ahead

Increasing demand for and usage of spiral refrigeration systems by the meat industry in particular has led to a massive growth in the global spiral freezer market carried out by **Allied Market Research**. Apart

from the meat industry, the seafood industry has also experienced a huge surge in demand for spiral freezers which is anticipated to help the market post stunning growth in numbers in the near future. The increasing demand for and transportation of packaged food items across the globe is also predicted to help the market in increasing its expanse across the globe. Lastly, rising concerns regarding the high environmental pollution caused by traditional refrigeration systems is expected to increase the demand for spiral refrigeration systems and help the market grow.
Among the main Italian manufacturers we can mention Sarp and Pigo.

Product launches by major companies

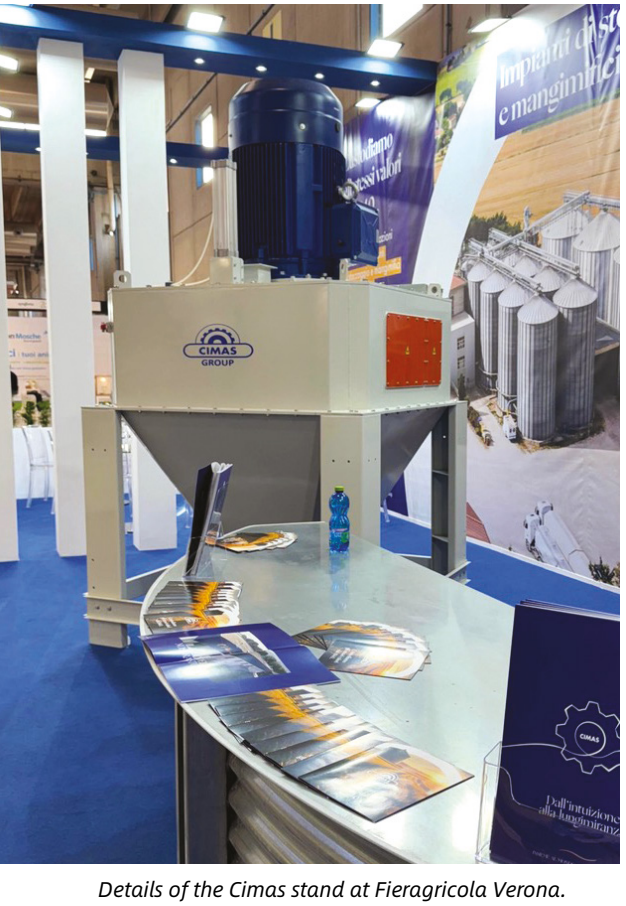
A huge chunk of the success experienced by the spiral freezer market is attributed to the technological advancements and innovative products launched by the leading companies in the industry. In March 2021, JBT Corporation, a leading American technology company, announced the launch of the Northfield CleanFREEZE™ spiral refrigeration system. This product launch brought a lot of appreciation to the company due to the product's high performance. On similar lines, in March 2022, Gea, a leading company in the food and beverages sector, announced the launch of ProEdge Drive, a series of new-age spiral refrigeration systems. With a freezing capacity of up to 3500 kg/hr., the product series has garnered a lot of attention due to its minimal carbon footprint.
Thus, despite certain challenges caused by governmental regulations and compliance measures, the spiral freezer market has experienced tremendous growth owing to its advantages over traditional freezers, increasing adoption by food processing industries, and innovative product launches by major companies.



(Sarp).

Cimas in Italy and around the world

At the last Fieragricola in Verona, Italy, saw **Cimas** confirmed its growth. A targeted and wide audience visited the booth and was entertained to learn about all the news, showing interest in the latest plants built, in Italy and in the world, demonstrating that the company has met the expectations of customers and prospects. Now specialized in the construction of feed mills and turnkey storage facilities, Cimas focuses on three elements: challenge, dynamism, optimism and investments in digital transition. In order for innovation to be the main objective in this constant change in the industrial world with particular attention to the agricultural and livestock sector, it has set itself the goal of continuous improvement in the production processes.



Details of the Cimas stand at Fieragricola Verona.

All the new 4.0 machines for raw material processing and sheet metal cutting with laser and plasma technology are a tangible demonstration of this, together with the simplification aimed at designing and implementing new simplified control systems. Redesign has aimed at maximizing performance efficiency and reducing energy consumption and waste dispersion.

In Africa Cimas has created new business opportunities, meeting the needs of an evolving market, for which the company is able to support high-profile assignments, respecting technical requirements, responding promptly to feasibility and making a new plant a real investment for the customer.

The system installed in Annaba has raw material reception and storage capacity consisting of two pits with a unit load capacity of 200 t/h. Two cereal pre-cleaning lines of 200 t/h each con-

Briganti feed mill in Cortona, Ar, Italy.
Plant for cleaning, storage and dosing of cereals and flours on 13 silos, total capacity 750 m³. Complete integration of the existing system with automatic cycles managed by the operator by means of PC and PLC.

sisting of: air tare valve with filter with counter-current bag cleaning; drum cleaner; motorized magnetic sorting machine; continuous control of the weight of the incoming cereal by means of 2 counter flow of 200 t/h; n. 20 flat-bottomed silos d.22 mt with a unit capacity of 5,000 tons; grain unloading capacity 200 t/h plant equipped with ventilation and temperature control

Starting from the right, counterclockwise Mattia Nataloni (export manager), 2 workers, Marco Nataloni, (administrative), and Genni Laurenzi (chief executive, office).

system; n. 2 silos for bulk loading cereals with a unit capacity of 200 tons.
Automatic management and supervision of the system take place via PLC and PC with dedicated software and video surveillance system. It also has a remote control for remote assistance.

Plant in Annaba, Algeria.
1,000 t of steel were used to build the 100,000 t cereal storage plant.

"Our presence at Fieragricola confirms our propensity to invest and to take entrepreneurial risks. The discussion with high-profile managers and the exchange of opinions with important Italian entrepreneurs was a stimulus and a confirmation: Cimas wants to be a protagonist in its reference sector. One of the fundamental aspects to better manage a company in the historical moment we are living, with truly unpredictable economic and social imbalances that create great logistical and relational supply difficulties, is to keep innovation and dynamism alive. What we have been trying to do in the company for 6 generations is this: to keep up with the technologies that our sector requires, to create new technologies and to always be highly competitive in terms of price and service offered", **Mattia Nataloni**, export sales director, says.

New project under construction: 40,000 t cereal storage plant, 30 t/h flour and 25 t/h pellet feed mill. Location: Dakar - Senegal.

(Cimas - Via Val di Rocco 42 - 06134 Ponte Felcino - PG - Italy - Tel. +39 075 5918339 - www.cimasitalia.it)

A reliable partner worldwide

Landucci is known worldwide for the high quality of the dies and the technology and reliability of the pasta forming machines. However, in the operating model, this is only the starting point. The relationship that the company establishes with the customers includes impeccable after-sales and service. In fact, considering that pasta production represents a delicate balance between traditional processing methods and the need to maintain consistent production volumes, in a competitive industry landscape, technical assistance plays a crucial role in ensuring operational continuity and product quality.

Continuous staff training

The dedicated service personnel are constantly trained and updated on the latest technologies and methodologies used in the pasta industry. This commitment allows us to offer the highest level of technical assistance, ensuring a quick diagnosis and timely solution to problems. The goal is to minimize downtime, helping to keep your production at peak performance.

State-of-the-Art technology

Landucci is constantly investing in technology, equipping the technicians with state-of-the-art instrumentation to make the work more efficient. Experience is thus combined with technology, sensitivity and intuition to measurement.

Upgrades and improvements

In addition to traditional assistance, Landucci offers upgrade services to improve the performance of already installed machines: it is able to optimize the machines in the pasta factory through software or hardware updates. The structured customer care office is always available to customers to coordinate these interventions and schedule preventive maintenance visits.

A global presence

The company is proud to be a strategic partner of prestigious pasta factories around the world, and presence and as-

The Velo 1400 machine for the production of Bologna pasta shape (Landucci).

sistance are guaranteed in a timely and professional manner in every part of the world. The ability to intervene on a global level is one of the elements that distinguish Landucci and make it a precious ally in the pasta supply chain.

Zamboni Brand Assistance

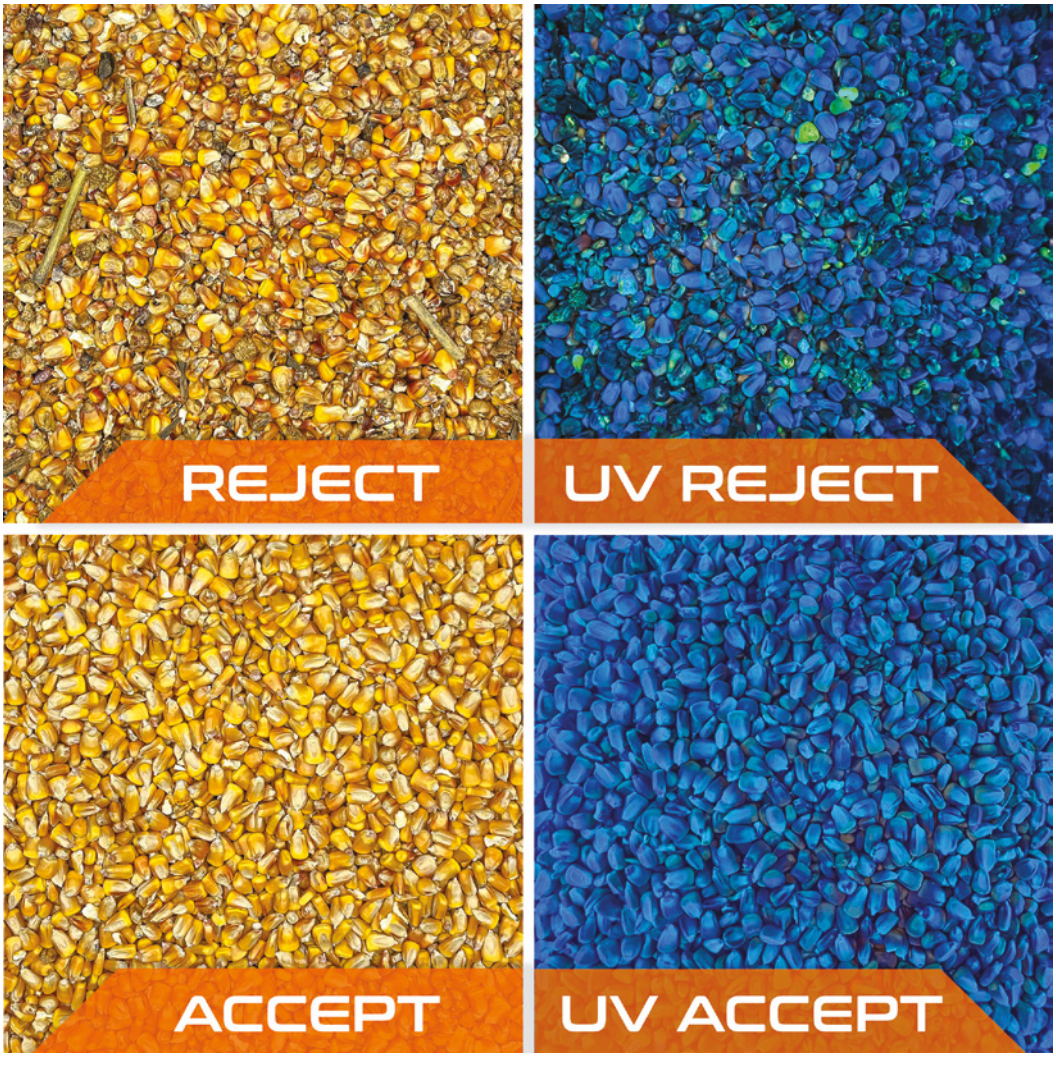
Landucci, with the recent acquisition of **Zamboni**, a leader in machines for the production of pasta Bologna, is now able to offer a complete and qualified assistance service for every Zamboni machine in the world: it is in fact possible to guarantee the same know-how and the same intervention capacity that is offered for the Landucci brand on these machines, providing support to all pasta factories that have owned this brand for a long time.
(Landucci - Via Landucci 1 - 51100 Pistoia - Italy - Tel. +39 0573 532546 www.landucci.it)

The state of the art in the fight against aflatoxins

Aflatoxins, mycotoxins mainly produced by two species of *Aspergillus*, a fungus widespread in hot and humid climate zones, are known for their genotoxic and carcinogenic properties.
They are generated by the secondary metabolism of certain species of filamentous micro fungi. They can develop during cultivation, harvest and storage on a wide range of plant origin products such as cereals (particularly maize), oilseeds (such as peanuts), spices, grains, nuts and dried fruits, and can also be present in the milk from animals fed contaminated feed. Their presence in food products includes also rice, figs, nuts, spices, raw vegetable oils and cocoa beans, which represents a risk to food safety. The consumer exposure through food must be kept as low as possible.
Several types of aflatoxins can be found in nature. The B1 aflotoxin is the most widespread in food products and one of the most potent in terms of genotoxicity and carcinogenicity. It is produced by *Aspergillus flavus* and *parasiticus*.
Climate change is expected to have an impact on the presence of aflatoxins in food in Europe, even crops in regions that currently have a temperate or cold climate may be affected in the future.
In this context, **3U Vision**, a company at the forefront of innovation in the field of grain and cereal sorting machines, offers a unique solution. Thanks to a registered patent, it has introduced **Fenix** and **Optica**, the machines capable of sorting simultaneously by ultraviolet and visible colour. This combination of technologies allows reduction of aflatoxins in maize with unprecedented precision, exceeding the capabilities of any other sorter available on the market.

Fenix and Optica can also be used to identify other fluorescence-emitting pest toxins, such as deoxynivalenol (DON) in wheat. They can also detect other mycotoxins, such as zearalenones in maize and T-2 and HT-2 toxins in oats. These toxins could have harmful effects on health if present in high amounts in cereals.

The difficulty of identifying these toxins makes 3U Vision's patent valuable. The multi-toxin detection capacity of Fenix and Optica makes these machines indispensable tools for ensuring the quality and safety of cereal products.
(3U Vision - Via Ugo La Malfa 20 - 40026 Imola - BO - Italy - Tel. +39 0542 1881791 www.3uvision.com)



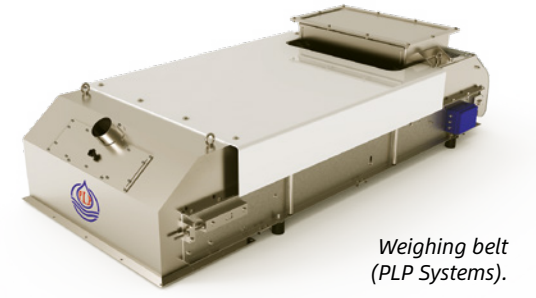
Micro powder dosing systems

PLP Systems is a leading company specialized in the research and development of technical machinery, and systems for the food, pet food, aquafeed, animal feed, chemical and cement industry.
Powder and liquid dosing systems for bakeries and the food industry enable precise and reliable dosing together with a clean and hygienic work environment. Materials that are difficult to handle can be dosed reliably and accurately with PLP's systems. The modern dosing systems help customers to offer their end products with better and more uniform quality. Thanks to the fast and accurate dosing, production capacity can be increased as well.
In fact, the use of liquid and powder micro ingredients in the modern food industry, as well as in feed and pet food mills, must be implemented using innovation, precision and cost effectiveness, whilst maintaining traceability throughout every stage of the application and avoiding cross contamination. Micro-dosing systems in industrial plants must provide a repeatable weighing capability while maintaining the same level of accuracy. Obviously, the more the weighing maintains good accuracy, the more attractive the machine is qualitatively. The sizing of the dosing devices and their feeding is the basis for achieving the desired results.
For these reasons, PLP Systems has developed the latest technology tailored to suit the demands of all the above-mentioned aspects. Such systems facilitate the addition of small quantities of both liquids and micro powders, they are able to organize production by automatically weighing all powder and/or liquid ingredients in recipes or preparation batches in all food productions where micro-dosages of ingredients are required. Guaranteeing the quality of the finished product, certainty of weighing accuracy, replicability of recipes, balance of raw materials and optimization of production time and costs.

Batch microdosing, MDP station (PLP Systems).

Continuous dosing of solids

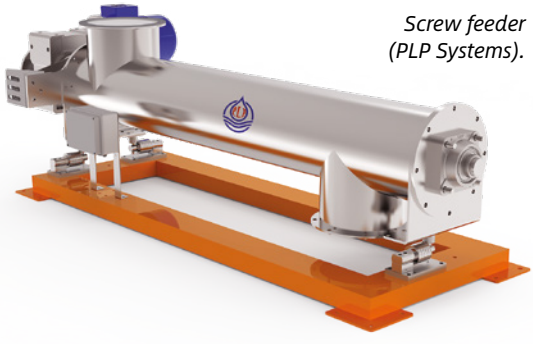
Weighing belt
The weighing belt is the ideal dosing system for delicate products which can break under mechanical actions. It is made by a motorized and a free roller, a roller carpet made of synthetic material, hoppers in stainless steel, support sides in aluminum and load cell. Also, it



Weighing belt (PLP Systems).

can automatically totalize the quantity of the dosed product, indicating the instantaneous delivery rate and the frequency output.

Screw feeder weighing machine
Entirely made in stainless steel, it is complete with n. 3 load cells and an encoder for the detection of weight and speed. According to the clients need, the weighing



Screw feeder (PLP Systems).

screw can be customized and the diameter of the screw and the rotations can be modified. The weighing screw automatically can totalize the quantity of the dosed product, indicating the instantaneous delivery rate and the frequency output.

Mass Spin Flow
Mass measuring device of continuous delivery rate, using an integrated torsion transducer and a processor of Coriolis farce data, the MSF is capable of instantaneously identifying the mass delivery rate of solid products: pellets, flours, kibbles; in general, any solid product of less than 2cm in size. It has a wide capacity range from 4 to 80 tons per hour.
Compared with traditional weighing systems, it has the advantage of: reduced bulk and ease of installation; does not disperse dust into the environment; does not need calibration or special configuration on changing to different products or far different specific weights; the electronic management indicates the instantaneous delivery rate and the totals; is designed with a frequency output for remote control;
For 2024, the goal of PLP is focused on respecting the environment, and is committed to expanding their technology and research, bringing to the market new innovations and ideas, while improving and increasing the economic benefits for the customer.
(PLP Systems - Via Provinciale sp 21 303 - 29018 Lugagnano Val d'Arda - PC - Italy - Tel. +39 0523 891629 - www.plp-systems.com)

Mass Spin Flow (PLP Systems).

Redefined standards with 3-year warranty program

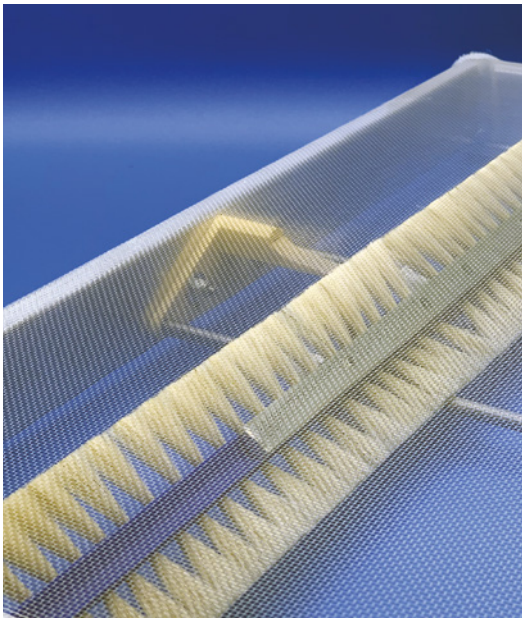
Being one of the world's leading companies in terms of food processing technologies with more than 1000 turnkey project references in more than 120 countries all around the world, **Alapala** realizes another first in its industry with the 3-year warranty program. The company redefines the sector standards in customer satisfaction with the program it offers for the turnkey factories it builds. **Görkem Alapala**, CEO of Alapala Holding, says: "Ensuring customer satisfaction and providing the best service is our primary goal. For this reason, we broke new ground in the industry and launched the 3-year warranty program for the turnkey factories. We believe in the projects and the team, and we guarantee the minimum resource utilization and maximum efficiency we create in our factories for 3 years by offering engineering and automation solutions from A to Z in line with the expectations of the customers".

The 3-year warranty reflects the company's 70 years of knowledge-based experience, innovation approach, and mission to offer more reliable and long-lasting solutions to the customers. Furthermor, it is an indicator of Alapala's confidence in quality standards and aims to ensure maximum efficiency.

(Alapala - Organize Sanayi Bölgesi 12. Cadde No:18 PK54 19040 Çorum - Turkey - Tel. +90 3642549560 - www.alapala.com)

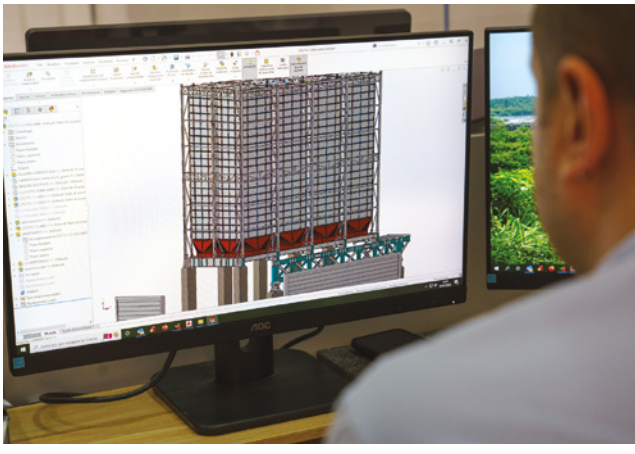
Development aimed for perfection

For over 50 years, **S.i.a.t.** produces industrial brushes. The modern technology allows to offer a high quality, reliable and durable solutions. The results confirm the professionalism and global presence.
The company is a leader in the milling industry and at the side to all manufacturers of flour processing plants and mills. The goal is to follow the customers and help them achieve the desired quality and provide them with a fast after-sales service that ensures maximum productivity.
(S.i.a.t. - Via Circonvallazione Ovest 53 - 40050 Castello d'Argile - BO - Italy - Tel. +39 051 977027 - www.siat.it)

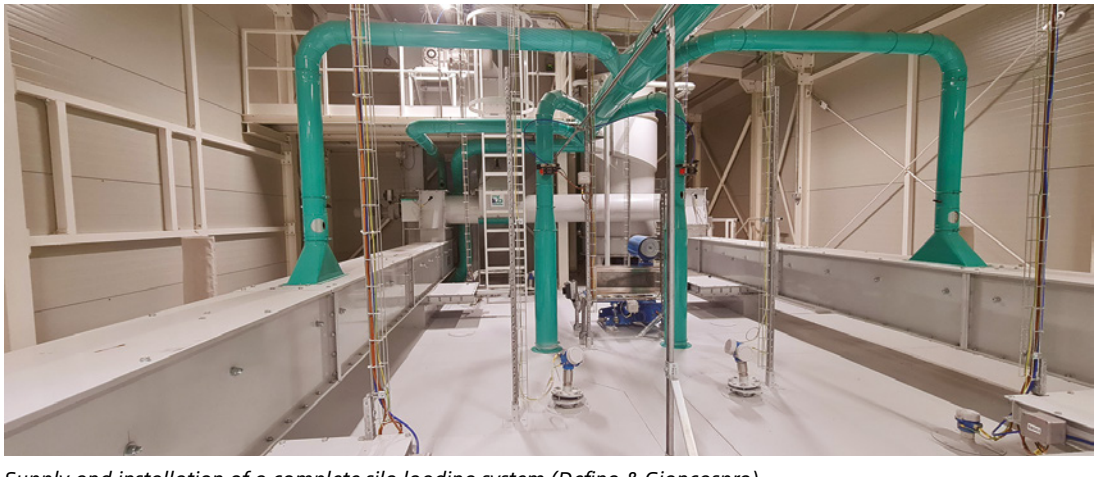


Made in Italy excellence in the milling industry

In more than 50 years of activity, **Defino & Giancaspro** has carved out an important role in the milling field, standing out for the design and construction of cutting-edge systems and machines.
The company has been able to adapt, over the years, to the changing needs of the market, becoming a point of reference for efficiency, constant innovation of the solutions proposed and the ability to create customized products.
The commitment towards its customers translates into a constant search for integrated solutions with the aim of meeting the most varied requests and needs, whether to set up a new project or to expand and improve the efficiency of an existing plant or production lines. This transversal intervention is possible thanks to a balanced mix of qualified engineers and specialized workers, who everyday work, side by side, blending ideas and experiences; design offices and an entire workshop with more than 80 technicians and workers placed at the customer's service.



Design of by-product storage system (Defino & Giancaspro).

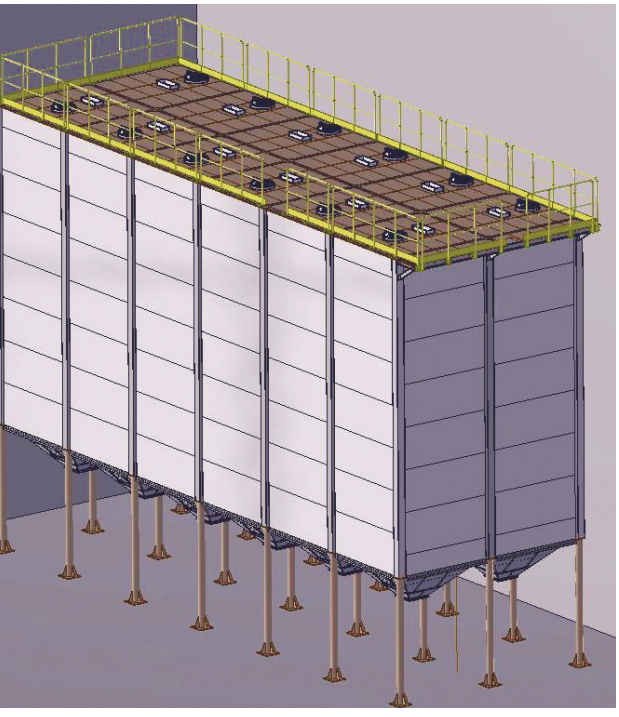


Supply and installation of a complete silo loading system (Defino & Giancaspro).

Metal structures, silos, pipes, accessories, and a wide range of machines, made with maximum precision and dedication, and in line with the highest standards in terms of quality and sustainability, as well as the guarantee in the application of MOCA standards regarding contact with foods, become a key factor for the success of a milling company.
The strength of Defino & Giancaspro is the ability to create tailor-made products capable of overcoming the standardization dictated by the market and by the reduction of production costs which often sacrifice the customer's needs to guarantee greater profits.
Furthermore, starting from 2021, the company has further improved its production lines, investing in new equipment. This evolution is not a simple adaptation to growing demand, but a complete transformation towards an increasingly intelligent and interconnected corporate reality. The integration of advanced technologies allows real-time monitoring, predictive maintenance and precise process control, ensuring maximum efficiency and safety.
On the basis of the historical experience in assembly and thanks to the renewal set in progress, the company has undertaken new challenges and aims to become a leader on the Italian and foreign markets also for the supply of complete systems for the storage of cereals and flour, managing the entire process from design and engineering to assembly and commissioning. An Italian excellence that looks to the future, without forgetting its past.
(Defino & Giancaspro - Via Archimede 27/33 - 70024 Gravina in Puglia - BA - Italy - Tel. +39 080 3266196 - www.defino-giancaspro.com)

New technologies for storage

For over 40 years, **Technobins** has specialized in designing and supplying industrial storage systems, particularly for the milling, feed, and food sectors. Now, as they prepare to relocate, the company is poised for a transformation.
The imminent move to a new, larger headquarters in Reggio Emilia, Italy, signals a shift in gears. A 3500 m^2 production center will be established, specializing in sheet metal processing. Equipped with state-of-the-art machinery for mechanical punching and robotic bending, the workshop will enable high levels of automation, speed, and precision in processing.
Technobins provides a comprehensive range of metal silos, both round and prismatic, that it includes: corrugated and spiral silos, as well as smooth bolted variants, e single and battery cells with smooth, or corrugated walls.
Recent orders have showcased the company advanced technology in the supply of "industrial buildings" that integrate storage silos. These structures feature cladding and roofing with sandwich metal panels, typically made of mineral



Innovative battery of completely smooth and self-cleaning pasta cells (Technobins).

wool. Additionally, they include essential accessories such as stairways, windows, skylights, and lifelines. These systems are delivered complete and constructed in compliance with current regulations, with a focus on ATEX and HACCP standards.

A significant development is the company's commitment to research and development in the pasta sector. Technobins has been serving pasta factories, primarily by supplying round smooth bolted silos for semolina and flour. Now, they are expanding their efforts to provide solutions across the entire pasta production chain: insulated silos for receiving and unloading tanks, featuring innovative ideas and dimensions; flat and smooth-walled cells for the reception and storage of semolina and flour; battery cells with flat and smooth walls for pasta storage, particularly for end-of-line warehousing.

These new solutions aim to optimize space utilization by incorporating shared walls and eliminating empty compartments that require cleaning. Moreover, they address concerns about dust accumulation and cross-contamination between products.

(Technobins - Via P. Nenni 4 - 42048 Rubiera - RE - Italy - Tel. +39 0522 943002 www.technobins.it)

Complete storage plant under construction for Molino Cerere in Bassano del Grappa (Vi - Italy): batteries of prismatic corrugated cells for wheat and smooth cells for flour (Technobins).

Single Shaft Ribbon Blender

Since the 1980s **MAP**, a division of **Wam-group**, develops a unique range of mixers to satisfy the needs of clients and to offer a professional solution for anything. With years of experience in mixing technology, today it can offer a new dedicated solution for almost every type of mixing problem. The **WBR Single Shaft Ribbon Blender** is a new generation of ribbon shaft mixers which combines reliable mixing quality with improved features and ergonomics. It is the solution to match market needs in terms of price-quality ratio, maintenance, safety and eco-friendliness.

Single Shaft Ribbon Blender WBR (MAP).

High mixing homogeneity for blending fragile and temperature sensitive products (MAP).

WBR consist of a horizontal, U shape mixing vessel, drive system and ribbon agitator. The mixing element is combined with inner and outer double helical ribbon. The outer ribbon moves materials into center direction and inner ribbon moves the materials in the opposite direction to shape radially and laterally movement.
The particular shape, position and rotation speed of the mixing tools, creates a centrifugal vortex motion, which allows the materials to be projected in a three-dimensional way and to merge with each other. This ensures that components with a different particle size and bulk density are blended and mixed with high precision within the shortest possible time.
The WBR is used for mixing of dry powders, granules or short fibres, for moistening, agglomerating or granulating the same materials, or for mixing small quantities of liquids or pastes with low viscosity.
MAP offers a vast range of solutions to improve plant productivity, to ensure production quality, to help protect the environment and reduce energy and maintenance costs. The comprehensive range of mixers consists of Ploughshare Mixers, Ribbon Blenders, Laboratory Mixers, Conical Screw Mixers and **Dustfix Dust Conditioners**. All configured for batch or continuous processes.
(MAP-Wamgroup - Via Cavour 338 - 41032 Ponte Motta di Cavezzo - MO - Italy - Tel. +39 0535 618111 - www.wamgroup.com)

Innovative solutions for pasta production facilities

With more than 170 project references and offering pasta production technologies with high efficiency in line with the needs of production facilities, Italian **Axor** provides flexible solutions to maximize the production efficiency of its business partners. With its production lines for different pasta cuts, turnkey projects and engineering solutions, it analyses the needs of producers and offers the most efficient plan for them.
Production facilities can produce pasta with different shapes and ingredients based on different types of raw materials. At this point, analysing the needs plays a critical role in the complete planning of production lines and processes. In the R&D center, the company is able to perform quality control tests for the specific needs of pasta producers and thus offer the most efficient plan for producers.
Thanks to the consultancy offered for project designs, pasta producers can minimize cost and time losses in the investments and achieve successful results in the projects. Axor enables pasta producers to use their capital in the most

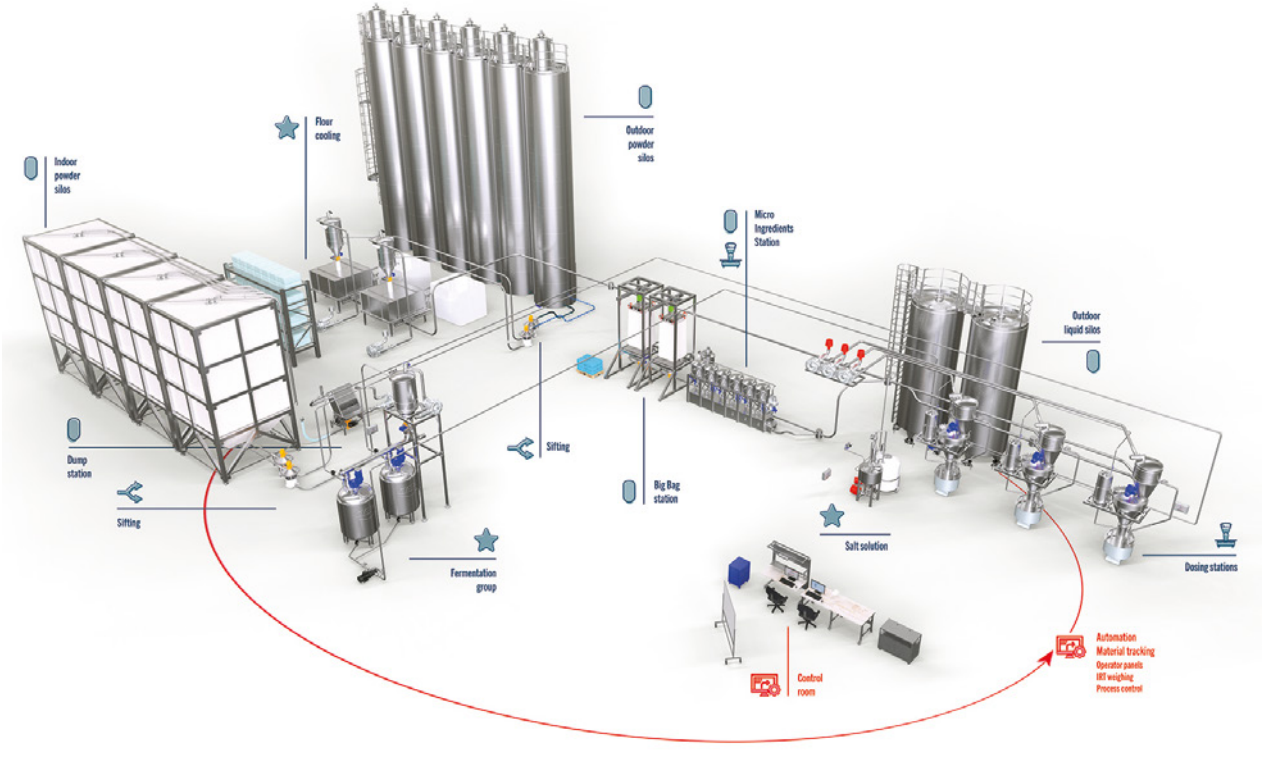
efficient way by providing a project plan that provides cost advantage and efficiency to optimize the processes in existing or to be established factories. It also offer flexible engineering solutions for all processes from automation to process control in pasta production facilities, making the production processes of enterprises efficient.
Axor is a solution partner in the turnkey projects of pasta producers, providing services from the construction of production facilities to the preparation of automation systems with more than 170 project references worldwide, tailor-made solutions prevent problems and time losses that pasta producers may encounter in producers' new investments.
(Axor - Via Maestra Grande 20 - 44045 Cento - FE - Italy - Tel. +39 051 6842166 com - www.axor-italia.com)

C as... circularity

Doing good by people and by the planet with partnership, prosperity and peace. **CEPI** aims to produce sustainable technology that protects the environment and gives back to the people it works with.

Bulk-handling: not just silos, but turn-key installations that are durable and circular

CEPI says this a lot, but bulk-handling isn't just about silos. As important as they are, storage operations are only one part of systems it builds. The company goal is to provide turn-key, highly customized solutions that manage the production line from storage to dosing. Turn-key is one crucial characteristic of its installations, and the other is organic: storage, dosing, transport and their automation must be regarded in their totality, and in the way they interact with each other. This is crucial to achieve effective customization, which in turn is what makes installations very durable.



CEPI takes a long-term view when it designs a bulk-handling system, to create the most flexible solution for each food manufacturer, one which does not preclude any new path they may take in the future. The design is based on a close analysis of the user's process, based on information that goes well beyond the purely technical. CEPI method involves all departments from warehouse, to production, technical, purchasing and marketing, to include projection of future productions. This is what makes its installations very easy to adapt to future developments.
One of its strengths is the ability to bring new life to installations that would otherwise be decommissioned. This activity, known as revamping, makes it possible to extend the useful life of the plants indefinitely: systems that CEPI built 30 years ago are still functioning efficiently.
The choice of basing our working model around being turn-key has been strategic. It makes users independent and meets their specific needs, and very importantly, it ensures that their process is efficient and sustainable, providing them with a durable installation that fits with the circular economy model.

CEPI's product is circular: what it means and why it is important

To gather more detailed information about the circularity of our product, CEPI has commissioned a study from an agency that applies the method identified by the Ellen Mac Arthur Foundation, one of the most authoritative international organizations in the field of the circular economy.
The circular economy model is rapidly establishing itself both in international policies and in consumption models, as an essential element of the transition towards sustainable development. It aims to enhance the recycling and reuse of raw materials and products, to reduce the consumption of primary resources. The Ellen Mac Arthur Foundation has developed an indicator that aims to measure the level of circularity of a product, evaluating information about the origin of materials, information about the characteristics of the product and its use, and information about the end of life of the product.
CEPI has been the first company in Italy to commission the evaluation of a bulk-handling system (as opposed to a single application). Its circularity indicator for the average system right now is 0,7 on a scale between 0 and 1, which is considered a very good result.
The materials are rated this way: suitable for reuse 83%, suitable for recycling 15%, disposal 2% and recycling efficiency 84%. This highlights a high quantity of reusable materials and materials sent for recycling.
What makes Cepi particularly proud is that the durability of their installations is 30 years on average, which it attributes both to high recycling efficiency and design method. It makes it clear how strategic a turn-key approach that aims for flexibility is, and how much efficiency, durability and sustainability overlap.
(CEPI - Via Selva 18 Z.I. La Selva - 47122 Forlì - FC - Italy - Tel. +39 0543 940514 www.cepisilos.com)

Food processing equipment

Given the evolving global food industry market situation, it is essential for **Sarp** to remain at the forefront of innovation and adapt to changing market dynamics. For this reason, the company is pleased to share exciting future prospects in the machinery sector for food production and processing.

Sarp stands out for technological innovation and attention to quality and the customer. For this reason, one of the key points in the coming months will be not only the updating of existing lines but also the development of new technologies. It is also investing significantly in the research into advanced process systems that improve efficiency and safety in food processing, thereby helping to ensure quality and compliance with regulations and continuous implementation needs.

Sarp is a company with solid experience in the food sector, specialized in the production of complete lines and machinery for pasta production and thermal treatment systems, such as spiral systems for cooling, freezing, pasteurization and proofing.

Processing system for donuts (Sarp).

Cooling and freezing line for bread (Sarp).

Its knowledge allows Sarp to offer a wide range of customized solutions, ranging from machinery relating to production up to the thermal treatment of food products in general with the use of spirals/towers for the treatment of bulk or post-packaging products. These treatments are applied in various fields from bakery products (as bread, pizza, etc.) to meat (as nuggets, hamburgers, etc.), from ice cream to fruit (fruit puree, fruit juice, fruit desserts, etc.).

Sarp is extremely proud of its ability to support its customers in choosing the right equipment and providing after-sales support. Sarp takes great care of the details, quality and commitment towards continuous innovation, constantly looking for new

technologies and ways to improve solutions and offer maximum value.
Some of Sarp top products include:

- Complete and combine pasteurization and cooling systems that allow production optimization, obtaining high-quality, intact products.
- Cooling and freezing systems with spiral towers that guarantee the freshness and shelf life of the products.
- Pasteurization systems for the safe process of products.
- Complete lines for the production of fresh and pre-cooked pasta, covering all stages from production to cooking/pasteurization.
- Machinery for the production of dried pasta, such as extruders and semi-automatic dryers.
- Customized solutions to meet specific customer needs.

Participation in upcoming fairs offers the company the opportunity to share its experience and solutions with professionals in the food sector. Sarp is excited to meet with potential business partners, customers, and collaborators to discuss how it can contribute to the success of their projects.
(Sarp - Via Montebelluna di S. Andrea 43 - 31033 Castelfranco Veneto - TV - Italy - Tel. +39 0423 482633 - www.sarp.it)

New merger to face the challenges of the future

Since last October, **Fava** and **Storci** have become a single entity: the company name is Fava S.p.A. and it combines both businesses and brands into a single entity making it more competitive and efficient on national and global levels.
With a turnover of over € 100 million, € 35 million net assets, two facilities that cover 26,000 m^2, 330 employees, over 50 of which are after-sales technical assistance people, making it the largest global player specialized in the research, design, manufacture and installation of pasta and couscous production equipment. Over 1500 pasta lines are in operation in the most important pasta factories in the world, representing 40% of the world market share and approxi-

From left Michele Storci and Luigi Fava.

Long pasta production line 400 FBL (Storci).

mately 80% of the Italian market share. These numbers characterize the union of two family-run companies currently in its third generation of entrepreneurs.
Such a merger can offer customers a complete range of equipment for every shape and size, subdivided into the various business areas: continuous dry pasta lines from 1,000 kg/h-12,000 kg/h; discontinuous dry pasta lines from 100 kg/h-1,200 kg/h; continuous couscous lines from 500 kg/h - 2,400 kg/h; fresh pasta lines from 100 kg/h-2,000 kg/h; instant pasta, fresh and frozen ready-meal lines for from 100 kg/h-4,500 kg/h. The new integrated commercial structure will cover the world market of industrial and artisan pasta factories in a more comprehensive manner, both for dry and fresh pasta products, with a unique selection and with the same quality, dedication and reliability that have always characterized Fava and Storci. The integration of the after-sales service, which provides a team of expert technicians, mechanics, software engineers and technologists, guarantees all customers a prompt and effective support service. The service to customers is completed with a series of Research and Development structures, equipped with top of the range machinery and equipment that revolve around the innovative Research Center in Cento, which coordinates the laboratories dedicated to specific product lines in Ferrara, Collecchio and Reggio Emilia in Italy.
The synergy that will be created with the integration of Storci, already part of the group since 1996, will lead to an

increase in efficiency of the entire production process, which will be shared between the two factories in Cento and Collecchio, improving the entire supply chain.
"It is a merger that projects us into the future and is in line with the times – says **Michele Storci**, Storci CEO –. The result is a stronger, more structured company, with an excellent capital and financial position, together with a combination of technical skills in the various fields that it will allow us to serve, with the same quality as always, from niche producers to large-scale industries. If I were to think of a mathematical representation of this merger, it would be a formula where the result is greater than the pure sum of the two components. A solid company in all its areas and flexible and quick in responding to its customers".
"The merger represents the natural evolution of a long path of success. Since 1996, together with the Storci family, we have become market leaders, gaining the trust of the most important pasta producers on a worldwide level. We have proved that we can face the difficult challenges that this exciting job poses us. The combination of skills, professionalism and sense of belonging with all our collaborators, is a strong point and will continue to distinguish us in providing the best products and services to our customers", says **Luigi Fava**, Fava CEO.
(Fava - Via IV Novembre 29 - 44042 Cento - FE - Italy - Tel. +39 051 6843411 - www.fava.it)

Long pasta production line GPL 180 (Fava).

THE POWER OF AN ENCOUNTER TOLD BY ENRICO FAVA

This merger marks a fundamental milestone for the future of our families and the activity. Families that have always been united by work which started when two men met and had the opportunity to get to know and respect one other. It was back in 1966 when **Barilla** decided to build a new factory to install high potential pasta lines that had never been manufactured before. I was personally involved in the project and this is when I met the people who were in charge of this new activity. **Anzio Storci** was one of the team members and he was in charge of the innovative technical and technological elements of the lines we were proposing. He was highly regarded by the owners. We got on right from the start as we understood one another. Mutual respect accompanied us throughout the years of this impressive project, which lasted from 1966 to 1971. We delivered 7 pasta lines to Barilla. Our paths didn't cross for a long time after that, until July 1995, when the company was faced with a major decision for its future, after separating from the historic trading company, we had to market and sell the own equipment. We had to set up our commercial network and integrate parts of the process line to provide the full package. This meant supplying the presses and press-head accessories. We had to find the right partner and fast. This is when I had a special person in mind who I knew could help me on such a challenging adventure. That person was Anzio. We met and I enthusiastically shared my idea with him i.e. combining our skills and building the presses together. We left that meeting with the agreement practically made, ready to start out on this new journey together. This is when Fava acquires 50% of Storci, located in Collecchio. It was very exciting to be back working together again and we achieved incredible results right from the start. Ours was the largest and most innovative press offered on the market up to that point. A press with a capacity of 4000 kg/h with many original and patented parts.

President Enrico Fava.

The companies also had another extraordinary strong point: the support and expertise of our sons, who have decided to merge the companies to become more competitive on the market, taking full advantage of well-established synergies together with the expertise of their employees. I am so proud of this merger as it is the evolution of that very special meeting.

Strategic move to consolidate the leadership position in the milling market

A Cremona-based company, top player in the milling sector, with a history of excellence and innovation, **Ocrim** announces the acquisition of **Sima** (Spresiano - TV, Italy), another key player in the panorama of storage facilities. This operation marks a significant step in the growth strategy, consolidating its position as a key player in the construction of milling plants, through the direct and specialized offer of complete solutions for storage plants.
Over the years, the company has earned a global reputation for providing advanced technologies and cutting-edge services in the milling industry. It has been a pioneer in integrating technological innovation with the practical needs of milling companies, offering tailor-made solutions that improve efficiency, quality and sustainability in the processing of wheat, corn and cereals in general.

A plant created by Sima.

From the left Sergio and Alberto Antolini, respectively president and CEO of Ocrim.

The acquisition of Sima – specialized in the design and construction of storage systems that guarantee the optimal conservation of raw materials and finished products – was a strategic move aimed at expanding Ocrim's offer and responding to the growing needs and requirements of the market. The integration of the skills of Sima – present in the sector for over forty years – will allow Ocrim to offer complete solutions, covering the entire production chain, thus integrating the storage of cereal and finished products in the mill. The two companies share values such as honesty and reliability, a sense of collaboration and availability and above all attention towards their human capital. Ocrim has always been an attentive and 360-degree prepared

supplier and certainly the construction of storage systems has always been part of its skillset. But this agreement concretely allows it to add a new piece to its industrial supply chain, as well as to the agri-food supply chain "The Italian Argi-Food Chain Choice", of which Ocrim has been spokesperson for eight years.
CEO **Alberto Antolini** says: "This acquisition represents an important step in the growth strategy. With SIMA's experience and expertise, we are ready to reach new levels of excellence and meet the growing needs of the customers and to respond to the increasingly complex requests of the market which is looking for loyal, strong and complete partners".

It is clear that Ocrim aims to capitalize on the synergies between the two companies, combining its experience in the milling sector with Sima's specialization in storage facilities. This integration will allow the Cremona-based company to offer more complete and competitive solutions on the market, positioning itself as an undisputed interlocutor in providing end-to-end solutions for the milling industry.In conclusion, the acquisition of Sima represents an exciting chapter in Ocrim's success story, that is preparing to reach new heights of excellence in the global milling market. (Ocrim - Via Angelo Massarotti 76 - 26100 Cremona - Italy - Tel. +39 0372 4011 www.ocrim.com)

Ipack-Ima 2025, a new strategy on innovation is coming

Technological innovation, the international competitive scenario, a strong presence in key global markets, business models, sustainability and an innovative exhibition formula and organisational approach were the topics discussed at the press conference in Düsseldorf last October organised by **Ipack-Ima** (to be held from **27** to **30 May 2025** in **Milan**, Italy) and **Ucima** (Italian packaging machinery manufacturers' association). The event offered a comprehensive overview of the state of the international packaging industry and We Make Packaging brand was also launched, which is intended to cover all the promotional activities undertaken by Ucima for the Italian packaging industry, both in Italy and abroad.

The press conference also discussed the development strategy adopted for the Ipack-Ima platform, conceived as an integrated and synergistic exhibition of the most innovative and important offerings in terms of technologies and materials, divided into four major areas of specialisation: grain based food, liquid food & beverage, pharma and chemicals. In addition, one of the real highlights of the show will be the sector of technologies and solutions for secondary and tertiary packaging, including the end-of-line stage, automation and robotics, coding and traceability systems.
According to **Valerio Soli**, president of Ipack-Ima, over the coming years will be concentrate the efforts on expanding and

innovating the range of offerings through Ipack Ima's integrated platform and on concepts such as digitalisation, technological innovation and sustainability, all of which are themes that are becoming increasingly topical and important for the industry. At Ipack-Ima 2025 the goal is to provide exhibitors and visitors with all the answers they need to identify, strengthen and expand the business trajectories of the companies present at the show, all of which represent the greatest capacity for innovation on a global scale. The exhibition will adopt a unique strategy and governance model based on a flexible approach to the market and its continuous changes in order to observe the industry in detail and provide a comprehensive view of technology and its future development. "The new strategy focuses on packaging technologies and materials for the target markets of the sectors hosted at the show, such as grain-based foods, beverage and liquid food, and pharmaceuticals. We also aim to bring together the transversal sectors that we have always hosted: secondary and tertiary packaging, end-of-line, traceability and coding, digitalisation and robotics. The aim is to combine intensive and multidisciplinary content while promoting extensive, effective and functional participation in terms of numbers, markets and international attendance. Our slogan, The Art of Innovation, refers to the inventive talent that has enabled the industry to develop the world's finest technical and technological solutions over the years and is intended to promote Ipack-Ima as the ideal venue for showcasing these skills through global technological excellence", said **Simone Castelli**, CEO of Ipack-Ima.

13th AISTEC conference on regenerative cereal supply chains

On **June 19-21** the 13th conference of the Italian Association of Cereal Science and Technology (AISTEC) will be held in Turin, at the Aldo Moro Auditorium of the University of Turin, co-organized by AISTEC, CREA and the University of Turin.
With the title "Regenerative cereal supply chain: climate change and new qualitative and nutritional needs", the conference will address the issue of the transition of cereal cropping systems and of the food chains connected to them to respond to the need to mitigate and adapt to climate change and to ensure production in line with the qualitative demands of the processing industry and society. Regenerative agriculture aims to preserve and regenerate the agricultural system, including the soil resource, and accumulate carbon, increase biodiversity and ecosystem services, ensuring the productivity of the system and the achievement of the nutritional and quality objectives of the supply chains. The same approach can be applied to all stages of the production chains, innovating technological processes, the organization of agri-food networks and

the use value of raw materials and food products to respond to the demand for sustainability posed by society. The Conference therefore intends to present and debate the recent scientific acquisitions related to cereals from the field to the table and to encourage the transfer of research results to the agri-food sector, within oral and poster scientific sessions, with particular reference to the following topics: regenerative agri-food models; product and process innovations; use value and nutritional quality of raw materials and foodstuffs; conscious consumption: communicating and certifying new supply chains; traceability and process and product markers; regulatory aspects and economic analysis.

During the conference, 2 cash prizes of €250.00 each will be awarded to the 2 best posters that will be selected by a jury of experts: **Chiriotti Editori Prize** named in memory of **Giovanni Chiriotti** – founder of this magazine –, for the best poster on innovative technologies in the field of cereal processing and use, and **"Tecnica Molitoria" Prize** for the best poster on the topics of the Conference reserved to young researchers (max 35 years).

Return to Parma Solids

After the success of the first edition, with the presence of 1,273 visitors and 119 exhibitors, **Solids** returns to Parma on **5** and **6 June 2024**, as the Italian event that brings together companies producing machinery for handling, storage, analysis and transformation of materials into granular, powdery form and loose solids.

Solids covers numerous product categories: food (coffee beans, flour, pasta, cereals), agriculture (feed, fertilizers, seeds), rubber and plastic, chemical-pharmaceutical, cosmetics, glass, metalworking and recycling.

Visitors are predominantly Italian and come from the geographical poles where the presence of relevant companies in the transformation of powders and solids is strong (Lombardy, Emilia-Romagna, Piedmont, Veneto and Tuscany). Of these, more than ¾ hold decision-making roles or are involved in purchasing and supply decisions: business unit managers, engineers, CEOs, sales directors, technical directors, researchers and more.

The 2024 edition will host the new Recycling Area with technologies and solutions for the recycling of materials, which have in common with bulk solids the management of granulates, powders and, specifically, recovery, disposal and valorisation of waste of production.

The recycling machinery market in Italy has a value of approximately 1.5 billion euros, with a growth forecast of 5% per year in the coming years. The main growth drivers of the market are the increase in separate waste collection, the introduction of new recycling technologies and increasingly stringent environmental regulations. In particular, the market for sorting machines (used to

separate waste into different fractions, based on type and value) is the one that is growing the fastest, thanks to the increase in separate waste collection. This process is fundamental for recycling, as it allows you to recover as many materials as possible. The market for treatment machines (to treat waste to make it suitable for recycling or other uses) is also growing, thanks to the introduction of new technologies that allow waste to be treated more efficiently and sustainably. The main manufacturers of recycling machines in Italy are companies that operate globally and invest in research and development of new technologies and products that meet market needs.

Solids Parma will not lack a conference section, which has already occupied great prominence during the 2023 edition. The topics that will be covered during the workshops and conferences concern hot topics: the Department of Mechanics of Granular Solids of the University of Padua will hold the conference "Flowability of powders and fluidity", on the impact of flowability on the outcome of processing. ATEX Italia will return to talk about "ATEX Directives: Earthing systems: transport of dust, addressing the topic of installations in 'Ex' areas".

Furthermore, the 2nd Search & Tech will be held on two key themes: the recycling of plastic and the treatment of recycled granules (curated by RePlanet Magazine) and Predictive Maintenance, AI, Vision in food (curated by Tecnoedizioni Group).

International events in Italy

The Chiriotti Editori Publishing house takes part at the **red coloured events**.

7-10 May 2024 - Cibus - Food show
Parma - www.cibus.it

28-30 May 2024 - SPS Italia - Automation and digital show - Parma - www.spsitalia.it

5-6 June 2024 - Solids - Powder and bulk processing show - Parma - www.solids-parma.de

19-21 June 2024 - Aistec - 13th Conference of the Italian Association of Cereal Science and Technology - Portici - www.aistec.it

8-12 September 2024 - IUFOST - World congress of food science and technology - Rimini
www.iufost.org

16-17 October 2024 - Save - Automation show - Verona - www.exposave.com

15-16 January 2025 - MarcabyBologna Fiere - Private label food show - Bologna
www.marca.bolognafiere.it

18-22 January 2025 - Sigep - Confectionery, pastry and ice cream show - Rimini
www.sigep.it

5-7 May 2025 - Zoomark - Pet show - Bologna
www.zoomark.it

8-11 May 2025 - TuttoFood - Food show - Milan
www.tuttofood.it

27-30 May 2025 - Ipack-Ima - Packaging and pasta industry show - Milan
www.ipackima.com

17-21 October 2025 - Host - Professional hospitality show - Milan - www.host.fieramilano.it

28-29 October 2025 - Cibus Tec Forum - Forum for the food industry - Parma
www.cibustec.it

27-30 October 2026 - Cibus Tec - Food show - Parma - www.cibustec.it

Worldwide events

10-11 April 2024 - MeetingPack - Packaging show - Valencia (Spain) - www.meetingpack.com

22-25 April 2024 - Djazagro - Food show - Algeri (Algeria) - www.djazagro.com

22-25 April 2024 - ICBC 2024 - Congress ICC on Cereal and Bread - Nantes (France) www.icc-icbc.com

13-15 May 2024 - Graintech - Milling industry show - Cairo (Egypt) - www.grainteche.com

14-17 May 2024 - Hispack - Food and packaging industry show - Barcelona (Spain) www.hispack.com

10-14 June 2024 - Achema - Chemistry show - Frankfurt (Germany) - www.achema.de

12-15 June 2024 - Propak Asia - Packaging show - Bangkok (Thailand) www.propakasia.com

18-21 June 2024 - Fispal Tecnologia - Food and packaging industry show - Sao Paulo (Brazil) www.fispaltecnologia.com.br

19-20 June 2024 - Snackex - Snack industry show - Stockholm (Sweden) - www.snackex.com

19-21 June 2024 - Propak China - Packaging show - Shanghai (China) - www.propakchina.com/en

19-21 June 2024 - Alimentec - Food show - Bogota (Colombia) - www.feriaalimentec.com/en

14-17 July 2024 - IFT Expo - Food technologists show - Chicago (USA) - www.iftevent.org

3-5 September 2024 - Anuga Horizon - Food show - Cologne (Germany) www.anuga-horizon.com

10-12 September 2024 - Propak West Africa - Packaging show - Lagos (Nigeria) www.propakwestafrica.com

23-24 September 2024 - Natexpo - Organic show - Lyon (France) - natexpo.com

24-26 September 2024 - FachPack - Packaging show - Nuremberg (Germany) www.fachpack.de

19-23 October 2024 - Sial - Food show - Paris (France) - www.sialparis.com

26-29 October 2024 - Südback - Baking show - Stuttgart (Germany) www.messe-stuttgart.de/suedback

3-6 November 2024 - Packexpo - Packaging show - Chicago (USA) - www.packexpointernational.com

4-7 November 2024 - All4Pack - Packaging show - Paris (France) - www.all4pack.com

5-7 November 2024 - Gulfood Manufacturing - Food industry show - Dubai (UAE) www.gulfoodmanufacturing.com

6-7 November 2024 - JTIC - Technical days for the cereal industry - La Rochelle (France) www.jtic.eu

12-14 November 2024 - SPS - Automation show - Nuremberg (Germany) - www.sps-exhibition.com

18-20 November 2024 - Swop - Process and packaging show - Shanghai (China) www.swop-online.com

3-5 December 2024 - Pacprocess MEA - Process and packaging show - Cairo (Egypt) www.pacprocess-mea.com

2-5 February 2025 - ProSweets - ISM Cologne - Confectionery industry show - Cologne (Germany) www.prosweets.com

14-16 May 2025 - Foteg - Food and beverage industry show - Istanbul (Turkey) www.fotegistanbul.com

18-22 May 2025 - Iba - Baking show - Düsseldorf (Germany) - www.iba.de/en

3-5 June 2025 - Victam International e VIV Europe - Food industry show - Utrecht (Holland) www.victaminternational.com - www.viveurope.nl

14-17 September 2025 - IBIE Baking Expo - Bakery show - Las Vegas (USA) - www.bakingexpo.com

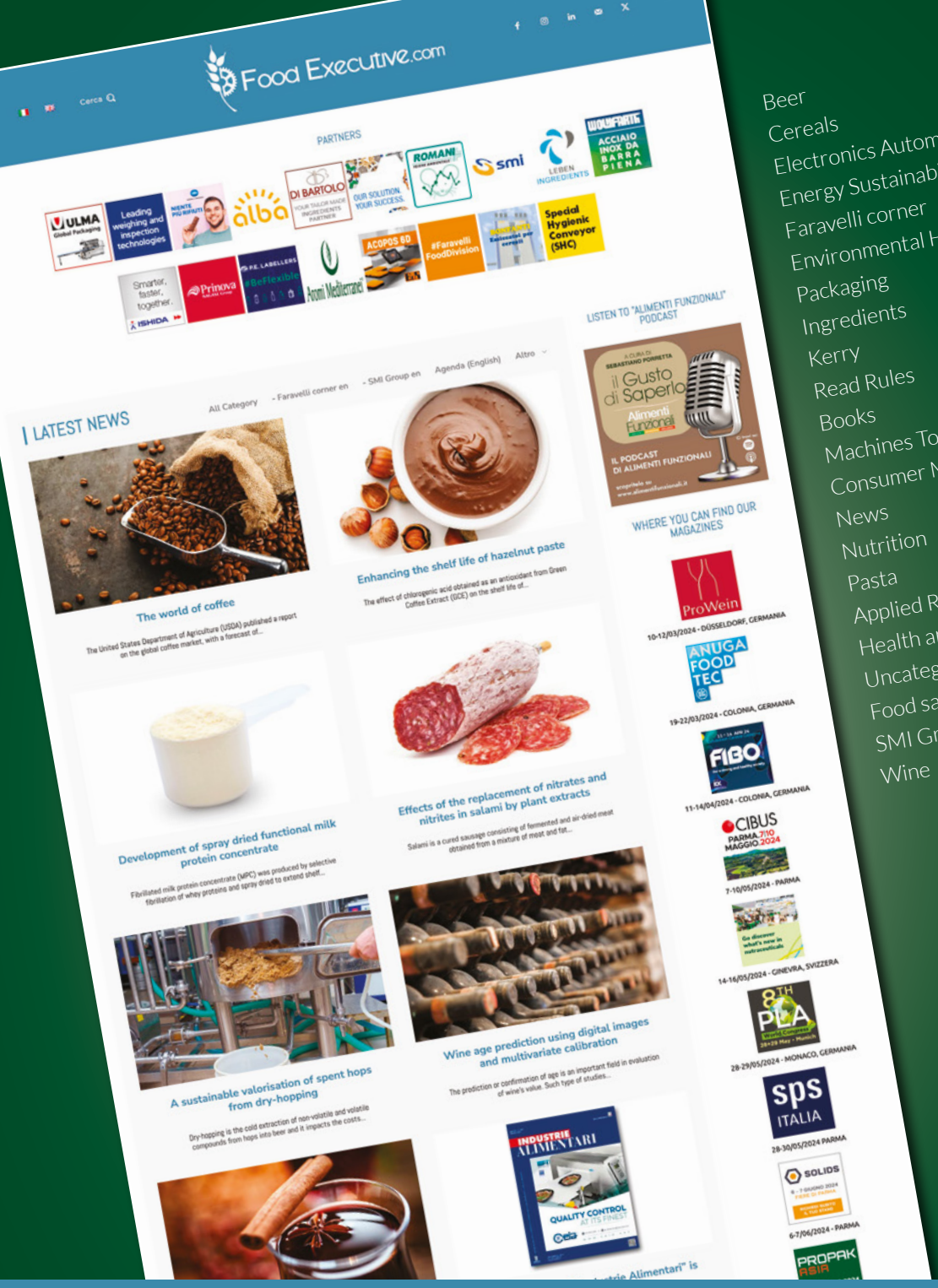
23-25 September 2025 - Powtech - Technologies for bulk show - Nuremberg (Germany) www.powtech.de

4-8 October 2025 - Anuga - Food show - Cologne (Germany) - www.anuga.com

28-30 October 2025 - Eats - Food industry show - Chicago (USA) - www.theeatsshow.us.messefrankfurt.com/us/en.html

7-13 May 2026 - Interpack - Packaging show - Düsseldorf (Germany) - www.interpack.com

6-9 October 2026 - Alimentaria Foodtech - Food industry show - Barcelona (Spain) www.alimentariafoodtech.com



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SUPPLIER DIRECTORY 2014

SUPPLIER DIRECTORY 2014

SUPPLIER DIRECTORY

		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**3U VISION SRL** Via Ugo La Malfa 20 40026 - Imola BO - ITALY +39 0542 1881791 info@3uvision.com www.3uvision.com	graders, sorters	✔	✔			
Name Street City Tel. E-mail web	**AGRINOVA SRL** Via Togliatti 52 12038 - SAVIGLIANO CN - ITALY +39 0172 715488 info@agrinova.it www.agrinova.it	cereal milling equipment belts brush sieves pipes, piping clothing, gaskets stitching ancillary equipment sleeves bucket elevators	✔					✔
Name Street City Tel. E-mail web	**ANSELMO IMPIANTI SRL** Via Fossano 33 12041 - BENE VAGIENNA CN - ITALY +39 0172 654755 anselmo@anselmoitalia.com www.anselmoitalia.com	pasta machines			✔		
Name Street City Tel. E-mail web	**ANTENORE VISENTIN SRL** Via Cartera 39 31100 - TREVISO TV - ITALY +39 0422 300311 info@antenorevisentin.com www.antenorevisentin.com	cereal milling equipment	✔	✔			
Name Street City Tel. E-mail web	**AXOR SRL** Via Maestra Grande 20 44045 - CENTO FE - ITALY +39 051 6842166 info@axor-italia.com www.axor-italia.com	pasta machines			✔		✔	
Name Street City Tel. E-mail web	**BECCARIA SRL** Via Sperino 46 12030 - SCARNAFIGI CN - ITALY +39 0175 274737 beccaria@beccaria.it www.beccaria.it	cereal milling equipment feed equipment silos hammer mills feed mixers extractors pneumatic conveyors	✔			✔		✔
Name Street City Tel. E-mail web	**BORGHI SRL** Via Paradello 7 45037 - MELARA RO - ITALY +39 0425 89689 info@borghigroup.it www.borghigroup.it	cereal milling equipment bucket elevators dust collectors, cyclones pipes, piping silos fans, blowers ancillary equipment sifters sieves hoppers rice milling trieurs	✔	✔		✔		✔
Name Street City Tel. E-mail web	**BRAMBATI SPA** Via Strada Nuova 37 27050 - CODEVILLA PV - ITALY +39 0383 373100 info@brambati.it www.brambati.it	pasta machines coffee equipment silos feeders, proportioners, dosers roasters crackers extractors peelers cutting machines peelers			✔	✔		✔
Name Street City Tel. E-mail web	**BÜHLER SPA** Via San Bovio 3 - San Felice 20090 - SEGRATE MI - ITALY +39 02 703111 buhler.milan@buhlergroup.com www.buhlergroup.com	washers pellet mills driers alveographs cereal milling equipment feed equipment pasta machines confectionery bakery equipment dampers sifters farinographs roller mills moisture testers silos pasta presses purifiers plansifter extruders coffee equipment cocoa processing machines granulators granulating machines degerminators rice millings courers hammer mills refiners pasta driers	✔	✔	✔	✔		✔
Name Street City Tel. E-mail web	**CAREDI SRL** Via Sant'Elena 52 31057 - SANT'ELENA DI SILEA TV - ITALY +39 0422 94073 info@caredi.it www.caredi.it	trieurs silos	✔			✔		
Name Street City Tel. E-mail web	**CBC SRL** S S 75 C. U. Km 4,190 - Z.I. 06083 - OSPEDALICCHIO BASTIA UMBRA PG - ITALY +39 075 808151 sales@concetti.com www.concetti.com	packaging equipment sacks filling machines palletizers depalletizers weight checker					✔	
Name Street City Tel. E-mail web	**CIMAS SRL** Via Val di Rocco 42 06134 - PONTE FELCINO PG - ITALY +39 075 5918339 commerciale.cimas@cimasitalia.it www.cimasitalia.it	silos	✔	✔		✔		
Name Street City Tel. E-mail web	**CIMBRIA SRL** Via Colombarotto 2 40026 - IMOLA - BO - ITALY +39 0542 361423 seainfo@agcocorp.com www.cimbria.com	graders, sorters	✔					✔

SUPPLIER DIRECTORY

		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**CMB SRL** Via Monte Pelmo 8 35018 - SAN MARTINO LUPARI PD - ITALY +39 0424 780176 info@cmbsrl.com www.cmbsrl.com	feeders, proportioners, dosers					✔
Name Street City Tel. E-mail web	**CMF FERRARI CARLO SRL** Via Venezia 3 25037 - PONTOGLIO BS - ITALY +39 030 7376774 amministrazione@cmf-italia.it www.cmf-italia.it	feed equipment flakers driers roller mills toasters sacks filling machines scourers			✔	✔	✔
Name Street City Tel. E-mail web	**COLOMBO PIETRO DI A. COLOMBO & C SNC** Via Marco D' Oggiono 21 - C.P. 63 64 23848 - OGGIONO LC - ITALY +39 0341 576251 info@colombopietro.it www.colombopietro.it	flour, feed, rice mills handling and storage sub supplying screws, worms ancillary equipment	✔				✔
Name Street City Tel. E-mail web	**CONCETTI GROUP** S S 75 C.U. Km 4,190 - Fraz. Ospedalicchio 06083 - BASTIA UMBRA PG - ITALY +39 075 801561 salesitaly@concetti.com www.concetti.com	packaging and bottlingh handling and storage packaging equipment sacks filling machines depalletizers palletizers palletizing robots stitching				✔	
Name Street City Tel. E-mail web	**CPS SRL** Via Montecassino 47 - Località Larghe 40050 - FUNO DI ARGELATO BO - ITALY +39 051 6647979 info@cpscucitrici.it www.cpscucitrici.it	stitching sacks filling machines				✔	
Name Street City Tel. E-mail web	**CRISTIANO TORRE SRL** Via Rezza 24/162 16033 - LAVAGNA GE - ITALY +39 0185 311991 torre@torre-eng.com www.torre-eng.com	analysis laboratories, tests					✔
Name Street City Tel. E-mail web	**CUSINATO GIOVANNI SRL** Via Monte Pelmo 8 35018 - SAN MARTINO DI LUPARI PD - ITALY +39 049 9440146 info@cusinato.com www.cusinato.com	pasta machines material handling and storage silos bucket elevators sieves sifters pipes, pipings crews, worms conveyor belts silos hoppers vibrators		✔			✔
Name Street City Tel. E-mail web	**D.V. SRL DEPURATION VEHICULER** Via E. Ellero 9 33080 - CUSANO DI ZOPPOLA PN - ITALY +39 0434 574192 info@dvsrl.com www.dvsrl.com	probes					✔
Name Street City Tel. E-mail web	**DEFINO & GIANCASPRO SRL** Via Archimede 27/33 - Zona Pip 70024 - GRAVINA IN PUGLIA BA - ITALY +39 080 3266196 info@defino-giancaspro.com www.defino-giancaspro.com	pipes, piping ancillary equipment cereal milling equipment	✔	✔			✔
Name Street City Tel. E-mail web	**DELLAVALLE SRL** Via Per Suno 2 28040 - MEZZOMERICO NO - ITALY +39 0321 97097 dellavalle@cerealmachinery.it www.cerealmachinery.it	rice milling aspirators, suction units, exhaust units dust collectors, cyclones scourers bucket elevators plansifter bleachers graders, sorters	✔				
Name Street City Tel. E-mail web	**DOLZAN IMPIANTI SRL** Via Roma 260 35015 - GALLIERA VENETA PD - ITALY +39 049 5969375 dolzan@dolzan.com www.dolzan.com	packaging equipment vffs vertical form fill seal machines vacuum packaging machines filling closing machines				✔	
Name Street City Tel. E-mail web	**DUETTI PACKAGING SRL** Via Leonardo da Vinci 43 35015 - GALLIERA VENETA - PD - ITALY +39 049 9471274 sales@duettipackaging.com www.duettipackaging.com	packaging equipment palletizers, carton formers, strecth wrappers				✔	✔
Name Street City Tel. E-mail web	**ELICA ASM SRL** Via della Tecnica 3/2 40050 - ARGELATO BO - ITALY +39 051 6630419 info@elica-asm.com www.elica-asm.com	graders, sorterspackaging					✔

SUPPLIER DIRECTORY

		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**ELVEM SRL** Via delle Industrie 42 36050 - CARTIGLIANO -VI - ITALY +39 042 4513972 mail@elvem.it www.elvem.it	motors	✔	✔			✔	
Name Street City Tel. E-mail web	**EUROFINS TECNA SRL** Area Science Park, LOC. Padriciano 99 34149 - TRIESTE TS - ITALY +39 040 3755341 tecna@tecnalab.com https://tecna.eurofins-technologies.com	analysis equipmentchemicalscleaning disinfection	✔					✔
Name Street City Tel. E-mail web	**FAVA SPA** Via IV Novembre 29 44042 - CENTO FE - ITALY +39 051 6843411 info@fava.it www.fava.it	pasta machines pasta presses pasta driers emulsifiers			✔			✔
Name Street City Tel. E-mail web	**FRAGOLA F.LLI SPA** Via Del Caminaccio 2 06088 - SANTA MARIA ANGELI PG - ITALY +39 075 805291 commerciale@fragolaspa.com www.fragolaspa.com	feed equipment silos crumblers pellet mills	✔			✔		
Name Street City Tel. E-mail web	**GENERAL DIES SRL** Via Strà 182 37030 - COLOGNOLA AI COLLI VR - ITALY +39 045 7650600 info@generaldies.com www.generaldies.com	feed equipment	✔			✔		
Name Street City Tel. E-mail web	**GRANAIR** Area industriale di Larisa - PO Box 3049 41500 - LARISA - GREECE +30 2410 541641 info@grainar.com www.grainar.com	yeast, leavens		✔	✔			⊕
Name Street City Tel. E-mail web	**GRESPAN IMPIANTI TECNOLOGICI SRL** Via Roma 144 31020 - CASTRETTE DI VILLORBA TV - ITALY +39 0422 608848 info@grespan.it www.grespan.it	feed equipment silos	✔			✔		✔
Name Street City Tel. E-mail web	**GROUP PACK SRL** Strada del Lavoro 71 47892 - ACQUAVIVA REPUBLIC OF S. MARINO - ITALY +378 0549 911186 info@group-pack.com www.group-pack.com	sacks filling machines	✔				✔	
Name Street City Tel. E-mail web	**GRUPPO PELLICOLA - MOLITECNICA SUD SNC** Cda Torre La Macchia 70022 - ALTAMURA BA - ITALY +39 080 3101016 info@molitecnicasud.it www.gruppopellicola.com	cereal milling equipment		✔				
Name Street City Tel. E-mail web	**IGUS SRL** Viale delle Rovedine 4 23899 - ROBBIATE LC - ITALY +39 039 59061 igusitalia@igus.it www.igus.it	ancillary equipmentholdersductschains						✔
Name Street City Tel. E-mail web	**IMAGIN SOLUTIONS SRL** Via Dante Alighieri 25 24030 - MEDOLAGO BG - ITALY +39 035 902103 info@bonfanti.eu www.bonfanti.eu	driers		✔	✔	✔		
Name Street City Tel. E-mail web	**IMECO – EFFEGIELLE SRL** Via delle Viole 23 26100-CREMONA CR - ITALY +39 0372 496826 sales@imeco.org www.imeco.org	Machines for dosing, weighing, bagging, palletizing, dampening controller and outflow free-flowing electronic controller.	✔	✔		✔	✔	
Name Street City Tel. E-mail web	**IMMAC SRL** Via Strada Nuova 25 27050 - CODEVILLA PV - ITALY +39 0383 373044 info@immacsrl.com www.immacsrl.com	cereal milling equipment roller mills plansifter material handling and storage aspirators, suction units, exhaust units		✔				✔

SUPPLIER DIRECTORY

		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**IST SRL** Via Corazza 22 44124 - FERRARA FE - ITALY +39 053 2099536 info@istsort.com www.istsort.com	graders, sorters	✔			✔		
Name Street City Tel. E-mail web	**ITALPACK SRL** Via Costa 106 47822 - SANTARCANGELO DI ROMAGNA RN - ITALY +39 0541 625157 italpack@italpack.net www.italpack.net	feeders, proportioners, dosers filling closing machines vffs vertical form fill seal machines sacks filling machines packaging equipment shrink tunnels					✔	
Name Street City Tel. E-mail web	**ITALSAVE SRL** Via Vecellio 13 31025 - SARANO DI SANTA LUCIA DI PIAVE TV - ITALY +39 0438 460640 info@italsave.it www.italsave.it	assistance, maintenance paints, lining, coating						✔
Name Street City Tel. E-mail web	**ITALVIBRAS SPA** Via Ghiarola Nuova 22 26 41042 - FIORANO MODENESE MO - ITALY +39 0536 804634 italvibras@italvibras.it www.italvibras.it	vibrators						✔
Name Street City Tel. E-mail web	**KONICA MINOLTA SENGING EUROPE B.V.** Viale Fulvio Testi 128 20092 - CINISELLO BALSAMO MI - ITALY +39 02 84948800 info.italia@bs.konicaminolta.it www.konicaminolta.eu	automation and controls	✔					✔
Name Street City Tel. E-mail web	**LANDUCCI SRL** Via Landucci 1 51100 - PISTOIA PT - ITALY +39 0573 532546 landucci@landucci.it www.landucci.it	pasta machines dies cutting machines washing machines			✔			✔
Name Street City Tel. E-mail web	**MAGNETICA TORRI SNC** Via Giovanni XXIII 10 25086 - REZZATO BS - ITALY +39 030 2594184 info@magneticatorri.it www.magneticatorri.it	ancillary equipment						✔
Name Street City Tel. E-mail web	**MAIN TECH SRL** Via Fornace I la Strada 16 35010 - San Giorgio delle Pertiche PD - ITALY +39 049 7968480 info@maintechworld.it www.maintechworld.it		✔					
Name Street City Tel. E-mail web	**MARANI SNC** Frazione Casalfoschino 16/BIS 43018 - SISSA TRECASALI PR - ITALY +39 0521 877223 info@marani.it www.marani.it	cereal milling equipment assistance, maintenance		✔				✔
Name Street City Tel. E-mail web	**MAZZOLARI SRL** Via Aldo Moro 14 - Z. I. Cignone 26020 - CORTE DE' CORTESI CR - ITALY +39 0372 926002 info@mazzolariricambi.it www.mazzolariricambi.it	ancillary equipment						✔
Name Street City Tel. E-mail web	**MIG SRL** Via Guglielmo Garconi 21 24040 - FORNOVO S GIOVANNI BG - ITALY +39 0363 351919 ufficioacquisti@migsrl.it www.migsrl.it	meat, fish equipment				✔		
Name Street City Tel. E-mail web	**MIX SRL** Via Volturno 119/a 41032 - CAVEZZO MO - ITALY 0535 46577 info@mixitaly.com www.mixitaly.com	ancillary equipment feed mixers filters granulators nozzles level indicators granulating machines	✔	✔				
Name Street City Tel. E-mail web	**MULMIX SRL** Via Palladio 7, Marsango 35010 - CAMPO SAN MARTINO PD - ITALY +39 049 9638211 mulmix@mulmix.it www.mulmix.it	feed equipment silos driers hammer mills	✔			✔		

SUPPLIER DIRECTORY

		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**NAMAD DI MADDALENA NANNI** Via Diano d'Alba 5/7 00166 - ROMA RM - ITALY +39 06 6140707 info@namadimpianti.com www.namadimpianti.com	analysis equipment					✔
Name Street City Tel. E-mail web	**NATRO TECH SRL** Via Copernico snc 24053 - BRIGNANO DI GERA D'ADDA BG - ITALY +39 0363 916130 info.natro-tech@mondigroup.com www.mondigroup.com/natro	sacks filling machines				✔	
Name Street City Tel. E-mail web	**NEWPHARM SRL** Via Tremarende 24/B 35010 - SANTA GIUSTINA IN COLLE PD - ITALY +39 049 9302876 info@newpharm.it www.newpharm.it	disinfestation					✔
Name Street City Tel. E-mail web	**NICCOLAI TRAFILE SRL** Via Cardarelli 19 - Z I Sant'Agostino 51100 - PISTOIA PT - ITALY +39 0573 92731 niccolai@niccolaitrafile.it www.niccolai.com	pasta machines dies washing machines dough sheeter cutting machines	✔				✔
Name Street City Tel. E-mail web	**NORD MOTORIDUTTORI SRL** Via Newton 22 40017 - SAN GIOVANNI IN PERSICETO BO - ITALY +39 051 6870711 info@nord-it.com www.nord.com	variable-speed drives, reducers	✔	✔			✔	
Name Street City Tel. E-mail web	**NTE Process SRL** Via Milano 14/N 20064 - GORGONZOLA MI - ITALY +39 02 9516875 info@nte-process.com www.nte-process.com	pilot plantslevel indicators	✔					⊕
Name Street City Tel. E-mail web	**OBR BULGARELLI SRL** Via Parri 3 42045 - LUZZARA RE - ITALY +39 0522 976972 obr@obr.it www.obr.it	ancillary equipment cereal milling equipment feed equipment				✔		✔
Name Street City Tel. E-mail web	**OCRIM SPA** Via Massarotti 76 26100 - CREMONA CR - ITALY +39 0372 4011 info@ocrim.com www.ocrim.com	cereal milling equipment silos roller mills cleaners pneumatic conveyors purifiers degerminators washers hammer mills	✔	✔		✔		
Name Street City Tel. E-mail web	**OFFICINE LOPORCARO SRL** Via Del Grano 1 - Z.I. 70022 - ALTAMURA BA - ITALY +39 080 3101167 info@loporcaro.it www.loporcaro.it	cereal milling equipment	✔	✔				
Name Street City Tel. E-mail web	**OLI SPA** Via Canalazzo 35 41036 - MEDOLLA MO - ITALY +39 0535 410611 info@olivibra.com www.olivibra.com	vibrators	✔					
Name Street City Tel. E-mail web	**OLOCCO SRL** Via Del Santuario 41 12045 - FOSSANO CN - ITALY +39 0172 692579 olocco@olocco.it www.olocco.eu	ancillary equipment valves pipe fittings pneumatic conveyors	✔					✔
Name Street City Tel. E-mail web	**PAGANI IMBALLAGGI SNC** Via G. Morandi 32 21047 - SARONNO VA - ITALY +39 02 96701343 info@paganiimballaggi.com www.paganiimballaggi.com	bundling machines sacks filling machines palletizers depalletizers palletizing robots sealing welding machines pallet wrapping, hooding machines				✔		
Name Street City Tel. E-mail web	**PAGLIERANI SRL** Via Santarcangiolese 5 47825 - TORRIANA RN - ITALY +39 0541 311111 info@paglierani.com www.paglierani.com	bundling machines sacks filling machines palletizers depalletizers palletizing robots sealing welding machines pallet wrapping, hooding machines filling closing machines				✔		

SUPPLIER DIRECTORY

		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**PARTISANI SRL** Via Buli 2 47122 - FORLI' FC - ITALY +39 0543 796165 info@partisani.com www.partisani.it	cereal milling equipment cleaners, stone mills	✔	✔			
Name Street City Tel. E-mail web	**PERKIN ELMER ITALIA SPA** Viale dell'Innovazione 3 20126 - MILANO - MI - ITALY +39 02 36012500 cc.italy@perkinelmer.com www.perkinelmer.it	analysis equipment					✔
Name Street City Tel. E-mail web	**PLP LIQUID SYSTEMS SRL** Via Provinciale SP 21,303 29018 - LUGAGNANO VAL D'ARDA PC - ITALY +39 0523 891629 info@plp-liquidsystems.net www.plp-liquidsystems.net	feed equipment, liquid and powder dosing, coating	✔			✔		
Name Street City Tel. E-mail web	**PRO-TECH ITALIA SRL** Via Guido Rossa 13/a 16012 - BUSALLA GE - ITALY +39 010/9642386 info@pro-techitalia.com www.pro-techitalia.com	material handling and storage silos conveyor belts bucket elevators hoppers packaging	✔	✔				
Name Street City Tel. E-mail web	**RAM ELETTRONICA SRL** Via Ospedaletto km 1,700 int D 76123 - ANDRIA BAT - ITALY +39 0883/553719 info@ramelettronica.it www.ramelettronica.it	electrical installation, automation and control		✔	✔	✔	✔	✔
Name Street City Tel. E-mail web	**RAMBALDO ANTONIO** Via Tessara 9/11 35010 - SANTA MARIA DI NON - CURTAROLO PD - ITALY +39 049 557094 info@rambaldoantonio.com www.rambaldoantonio.com	ancillary equipment						✔
Name Street City Tel. E-mail web	**RICCIARELLI SPA** Via U. Mariotti 143 - Z I SANT'AGOSTINO 51100 - PISTOIA PT - ITALY +39 0573 44571 info@ricciarellispa.it www.ricciarellispa.it	weighers, scales			✔		✔	
Name Street City Tel. E-mail web	**RIMA SRL** Via Viazza Sinistra 2 40050 - MEZZOLARA DI BUDRIO BO - ITALY +39 051 805912 rimarticolitecnici@libero.it www.articolitecnici.it	stitching sacks filling machines ancillary equipment					✔	✔
Name Street City Tel. E-mail web	**ROSA CATENE SPA** Via San Rocco 5/b 23801 - CALOLZIOCORTE LC - ITALY +39 0341 630294 rosa@rosacatene.com www.rosacatene.com	chains	✔	✔			✔	✔
Name Street City Tel. E-mail web	**SAINT GOBAIN ABRASIVI SPA** Via per Cesano Boscone 4 20090 - CORSICO MI - ITALY +39 02 44851 stefano.natalicchio@saint-gobain.com www.saint-gobain.com	sieves						✔
Name Street City Tel. E-mail web	**SARP srl** Via Montebelluna 43 - loc. S. Andrea o. m. 31033 - CASTELFRANCO VENETO TV - ITALY +39 0423 482633 sarp@sarp.it www.sarp.it	fresh pasta machinery proving tunnel freezing tunnels pasta machines fresh pasta pasteurizers			✔			
Name Street City Tel. E-mail web	**SCOLARI SRL** Via Romiglia 2 25050 - PADERNO FRANCIACORTA BS - ITALY +39 030 6848012 info@scolarisrl.com www.scolarisrl.com	flour, feed, rice mills driers	✔					
Name Street City Tel. E-mail web	**SEFAR ITALIA SRL** Via Nazioni Unite 44 10093 - COLLEGNO TO - ITALY +39 011 42001 info@sefar.it www.sefar.it	ancillary equipment textiles frames						✔

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		Cereal Equipment	Mills	Pasta	Feeds	Packaging	Ancillary
Name Street City Tel. E-mail web	**SGM LEKTRA SRL** Via Papa Giovanni XXIII 49 20090 - RODANO MI - ITALY +39 02 95328257 info@sgm-lektra.com www.sgm-lektra.com	automation and controls	✔	✔				✔
Name Street City Tel. E-mail web	**SIAT SRL** Via Circonvallazione Ovest 53 40050 - CASTELLO D'ARGILE BO - ITALY +39 051 977027 info@siat.it www.siat.it	brushes						✔
Name Street City Tel. E-mail web	**SIMA SRL** Via Marmolada 15 - Z I Nord 31027 - SPRESIANO TV - ITALY +39 0422 881034 info@simaimpianti.net www.simaimpianti.net	ancillary equipment dust collectors, cyclones aspirators, suction units, exhaust units	✔			✔		
Name Street City Tel. E-mail web	**SIRCEM CM SPA** Via Armando Diaz 19 84018 - SCAFATI SA - ITALY +39 081 8631205 sircem@sircem.it www.sircem.it	pasta machines silos feeders, proportioners, dosers pneumatic conveyors filters bucket elevators control panels industrial pc			✔		✔	
Name Street City Tel. E-mail web	**TECALIT SRL** Via Leonardo 60 35018 - SAN MARTINO DI LUPARI PD - ITALY +39 049 9460985 tecalit@tecalit.it www.tecalit.it	pasta machines pasta presses pasta driers			✔			✔
Name Street City Tel. E-mail web	**TECHNOBINS SRL** Via P. Nenni 4 42048 - RUBIERA RE - ITALY +39 0522 943002 techbins@tin.it www.technobins.it	material handling and storage silos	✔					
Name Street City Tel. E-mail web	**TECNOGRAIN CARLINI SRL** Via Aldo Moro 23 46010 - CURTATONE MN - ITALY +39 0376 478584 info@tecnograin.com www.tecnograin.com	refrigerating units	✔					✔
Name Street City Tel. E-mail web	**TUBIMONT SRL** Corso Asti 2 I 12050 - GUARENE CN - ITALY +39 0173 228414 info@tubimont.it www.tubimont.it	feeders, proportioners, dosers						✔
Name Street City Tel. E-mail web	**VEGA ITALIA SRL** Via Fermi 8 20090 - ASSAGO MI - ITALY +39 02 8914081 info.it@vega.com www.vega.com	automation and controls	✔	✔			✔	✔
Name Street City Tel. E-mail web	**VERDI SPA** Via Volta 7 1 42024 - CASTELNUOVO DI SOTTO RE - ITALY +39 0522 683899 info@verdispa.com www.verdispa.com	ancillary equipment bucket elevators screws, worms conveyor belts level indicators						✔
Name Street City Tel. E-mail web	**WAM ITALIA SPA** Via di Sotto 9/A 41032 - PONTE MOTTA DI CAVEZZO MO - ITALY +39 0535 740111 gianni.salvioli@wamgroup.com www.wamgroup.com	material handling and storage ancillary equipment conveyors valves						✔
Name Street City Tel. E-mail web	**ZANIN F.LLI SRL** Viale Delle Industrie 1 31032 - CASALE SUL SILE TV - ITALY +39 0422 785444 info@zanin-italia.com www.zanin-italia.com	driers ancillary equipment	✔					✔
Name Street City Tel. E-mail web								

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