Experimental trials to evaluate risks from noise and particulate matter in a pasta factory

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Abstract

The trials were carried out in a pasta factory in Bari Province and confirmed that the existent studies regarding health risks in the pasta production sector can be used as the starting point. However it is necessary to make a specific analysis of the parameters which constitute risk factors, using scientific apparatus.

Evaluation of the risks deriving from noise involved a problem of interpretation. The differences found between data obtained with a phonometer and data obtained with a dosimeter may be in contrast, and the dosimeter data can be a source of concern for the workers' health and therefore for their employers who are responsible for health and safety. In actual fact, when the reality of the situation was examined, it was seen that different plant operations involve workers' movements which can stress the microphones differently from acoustic pressure. Therefore, the noise levels which are actually indicative of the situation in the workplace are the phonometer data. However, these too were quite high: daily exposure levels of over 80 dB(A), 85 dB(A) and 90 dB(A) in one case, while the impulsive noise levels were always lower Lpk=112 dB(C).

Evaluation of the risk from exposure to particulate matter showed concentrations of inhalable particulate matter PM 10 which were constantly below the level of TLV-TWA = 0.5 mg/m^3 adopted by the ACGIH as the maximum inhalable dose in eight hours of work. This shows the efficiency of the dust extractor system, which the firm recently upgraded.

However, we looked at preventive measures which consisted of:

- **working regulation defined by applying industrial health and safety procedures ;**
- **correct and continuous maintenance of the extractor system;**
- **identification of workers who are more susceptible to respiratory diseases – mostly caused by semolinas powder - even when exposed to levels below TLW.**

This study has further confirmed that the risk evaluation is not an *exact science*; in that it does not consist only of technical and mechanical factors, but needs also to consider the many factors connected to workers' interaction with the workplace.

Keywords: phonometer and dosimeter measures, semolinas powders, TLV-TWA levels, safety procedures.

Introduction

Pasta factories are highly mechanised, particularly at the stages of production when the pasta is extruded, dried and packaged (Matteucci D., Rabazzi S. 2007). This means that the machinery used is increasingly efficient, but can create dust and noise pollution (Cappelli M., Coscia M. 2005). The development of mechanised systems for the production cycle leads to changes in the lay-out of the workspace, in the types of work carried out by the workforce, and in the interaction between man and machine. Consequently the methodologies and the tools used to evaluate risks in the workplace also change, because they depend on the health problems and accidents which can happen during the production process, and also on the limits imposed by the technical regulations – which often translate into legal obligations (Benvenuti F. et al. 1998).

When it comes to dust, some authors have highlighted cases of conjunctivitis in factories using products similar to semolina flour (Ames R.G. 1991) which need further study in order to better define the correlation between cause and effect. The dangers of prolunged inhalation of flour dust in terms of chronic respiratory disease are little known, unlike the results of some scientific studies on other agri-food products (Becklake M. et al. 1997; Cassano F. et al. 2000; Jayawardana P. and Udupihille M. 1996; Zock J.P. et al. 1995).

Noise pollution is caused by the highly mechanised plants installed in the last few years, and risk assessment is correlated not only to the kind of machinery used, but also to other factors like the degree of maintenance, the positioning of machinery in the buildings, the structure of the buildings etc. (Di Candia E., Mongelli C. 1996; Cascone G. et al. 1996). Such problems are often experienced in the agricultural and agro-industrial sector, particularly during the sorting and packing phases (Merseburger A. 1996).

Considering the economic importance of this sector, and the problems concerning working conditions, the objective of this study was to evaluate risks from dust and noise in an Apulian pasta factory in a country area of the Province of Bari, also in relation to the limits set by the current legislation and the technical regulations (ACGIH, 2006; D.Lvo n. 81/2008).

Table 1. Main technical characteristics of the studied factory.

Company name	Location	Products	Working capacity	Personnel organization
Riscossa Pasta factory F.lli Mastromauro S.p.A	Corato (BA) – Apulia - Italy	- Dry pasta: pasta factory - Matasse – egg pasta: pasta factory - Rice: associate factories - Peeled tomatoes: associate factories - Pureed tomatoes: associate factories - Flour and semolinas: associate factories	– Long pasta line: 3500 kg/h – Long pasta line: 2000 kg/h – Short pasta line: 3500 kg/h – Short pasta line: 2200 kg/h – Short pasta line: 1200 kg/h – Matasse line: 400 kg/h – Matasse line: 700 kg/h – Special shapes line: 400 kg/h	– n. 13 clerical workers; – n. 80 workers; – n. 3 managers; – n. 1 chairman.

Materials and methods

The experimental trials were carried out in the pasta factory Riscossa in Corato (BA - Italy) which produces short and long pasta, matasse, egg-pasta and special shapes. Production is concentrated on short and long pasta lines which have working capacity of 35 q/h and about 20 q/h (table 1), and are situated near the outside walls of the building (figure 1).

In order to evaluate the risks of exposure to noise and dust inhalation, we examined the production cycle and its layout. Then we identified the *critical areas* for these risk factors, based on dust and noise generated, and on the movements of the factory personnel.

In fact, production takes place in a single working area (figure 1) where the pasta is prepared and extruded, dried and packaged. The workforce (n. 80 workers) is concentrated in the area of the presses and in the storage/packaging area, because the drying stage is completely automated and only requires workers to be present occasionally in order to carry out checks. For this reason, the equipment for measuring noise and dust was placed in n. 6 representative positions:

- presses area for the short pasta line (sample point 1 in figure 1);

- presses area for the long pasta line (sample point 2 in figure 1);
- area between the dryers and the storage area for the short pasta line (sample point 3 in figure 1);
- area between the dryers and the storage area for the long pasta line (sample point 4 in figure 1);
- short pasta packaging area (sample point 5 in figure 1);
- long pasta packaging area (sample point 6 in figure 1).

Evaluation of noise risk

Evaluation of the risk from exposure to noise was carried out in accordance with Italian laws (D.Lvo n. 81/2008) which correspond to EC Directive 2003/10/CE.

We measured weighted and instant noise levels, using: Quest phonometers integrators/dosimeters, Noise pro DLX-1 Model; Phonometer VI 400 Pro 8248; corresponding to the following standards:

- ANSI S1.25 – 1991, ANSI S1.4 – 1983: Class/Type 2, Class/Type 1;
- IEC 651 – 1979: Class/Type 2, Class/Type 1;
- IEC 804 – 1985: Class/Type 2, Class/Type 1;
- IEC 1252 – 1993;
- IEC 61672-1, Class/Type 1.

We determined the Continuous Equivalent Level (*Leq*) in order to reduce the effect of phonometric fluctuations. This represents the level of a hypothetical constant noise, with the same duration and equivalent energy level, as the variable noise measured; it is the average total noise. The environmental noise measurements were weighted according to Curve A, which is closest to the sensitivity of the human ear to the different frequencies, while impulsive noise measurements were weighted according to Curve C.

According to international regulations ISO 1999: 1990, partially acknowledged by Italian law, the level of daily exposure to noise is expressed by the formula:

$$L_{EX},d = LAeq,\tau_e 10\log\frac{\tau_e}{\tau_0} \qquad (1);$$

where:

$$LAeq,\tau_e = 10\log\left[\frac{1}{\tau_e}\int_0^{\tau_e}\left(\frac{p_A(t)}{p_0}p_A\right)^2 dt\right] \qquad (2);$$

with:

τ_e = daily duration of personal exposure of a worker to noise, including the daily share of over-time work;

τ_o = 8 h = 28.800 s;

p_o = 20 μPa;

p_A = instant acoustic pressure weighted in Scale A.

The average daily level of exposure per task was calculated according to the levels obtained for every work place using the following ratio:

$$L_{EX},8h = 10\log\sum 10^{0.1L_{EX,d}} \qquad (3)$$

Numerical processing of the data was carried out using periodically up-dated Quest software, mod. QuestSuite professional, rev. 1.70 e QuestSuite professional II.

Before and after each series of measures, the instruments were calibrated using a calibrator Quest mod QC 10/20, corresponding to the following standards:

- ANSI Standard for Sound Calibrators S1.40-1984;
- IEC 942-1988 for Sound Calibrators.

A phonometer was installed in each sample point for 8 hours and for shorter periods, which results represent the working day: 120 min, 47 min.
All phonometers were adjusted in accordance with the legal requirements (D.Lvo n. 81/2008) before noise levels were measured.

In order to take personal noise measurements, dosimeters were worn by:

- n. 3 factory workers and n. 1 wiring maintenance technician, mostly at work near the presses and occasionally at the dryer;
- n. 4 factory workers mostly at work in the packaging area and occasionally at work in the storage area and at the final part of the dryer.

These tests were also repeated, with workers wearing the dosimeter for 8 h and shorter periods of time which results represent the working day: 38 min, 39 min, 40 min, 46 min, 47 min, 52 min, 57 min; in these last cases it was also necessary to determine the level of L_{EX},8h, according to (1) and the (3) because these workers worked on the line for 4-6 hours, and then worked in quieter areas ($LAeq, \tau_e$ = 70 dB(A)) for the rest of the time.

Evaluation of dust risk

When we talk about "atmospheric dust" we intend a mixture of solid and liquid particles suspended in the air. These vary in dimension, composition and origin, according to how they were formed. Some of the particles which make up atmospheric dust are emitted by natural and man-made sources (primary particles); others derive from a series of chemical and physical reactions which take place in the atmosphere (secondary particles). Total suspended dusts (*PTS*) consist of a very heterogeneous set of solid and liquid particles which are small enough to remain suspended in the air.

Dusts are classified according to the diameter of the particles and their concentration in the air is expressed in $\mu g/m^3$. The diameter of particles can vary from a minimum of 0,005 µm to a maximum of 100 µm. Within this range, particles are defined as:

- coarse, with diameter included between 2,5 and 30 µm;
- fine, with diameter lower than 2,5 µm.

The smaller of the dust particles, have greater capacity to penetrate into the lungs and to cause health problems. This is why Italian laws about air pollution regulate the presence of particles *PM* (paticulate matter) *10* with diameter lower than 10 µm in the air, including a sub-group of finer particles called *PM2,5* with diameter lower than 10 µm. Although these dusts have different chemical compositions and behave differently in the atmosphere, about 60% consists of the finest particles.

The *PM10* are more interesting in health terms than *PTS*. and are also called *inhalable dusts* because they can penetrate past the larynx. *PM2,5* are called *respirable dusts* because they are able to penetrate into the lower reaches of the respiratory system (from the trachea to the lung alveoli).

The levels of dust were measured in a fixed sample point, in order to evaluate the exposure of each worker to the most dangerous dusts, that is to say the *PM10*; a direct-read dust analyser measures how the dust particles inside its sample chamber refract the light emitted by a laser diode. The sampled air flow is crossed by a light with a wavelength of 780 nm. Refraction varies according to particle granulometry and the refractive index, and is proportional to the quantity of dust contained in the sample. In fact, the particles refract the light in all directions and it is then captured by a photometer at an angle of 90° to the laser beam and to the sample air flow. The light is then converted electronically into a number proportional to the concentration of dust. The proportional factor used by DustTrack is calculated with reference to the A1 Arizona american Test wich follows the standard legal calibration ISO 12103-1. The apparatus has a calibration certificate.

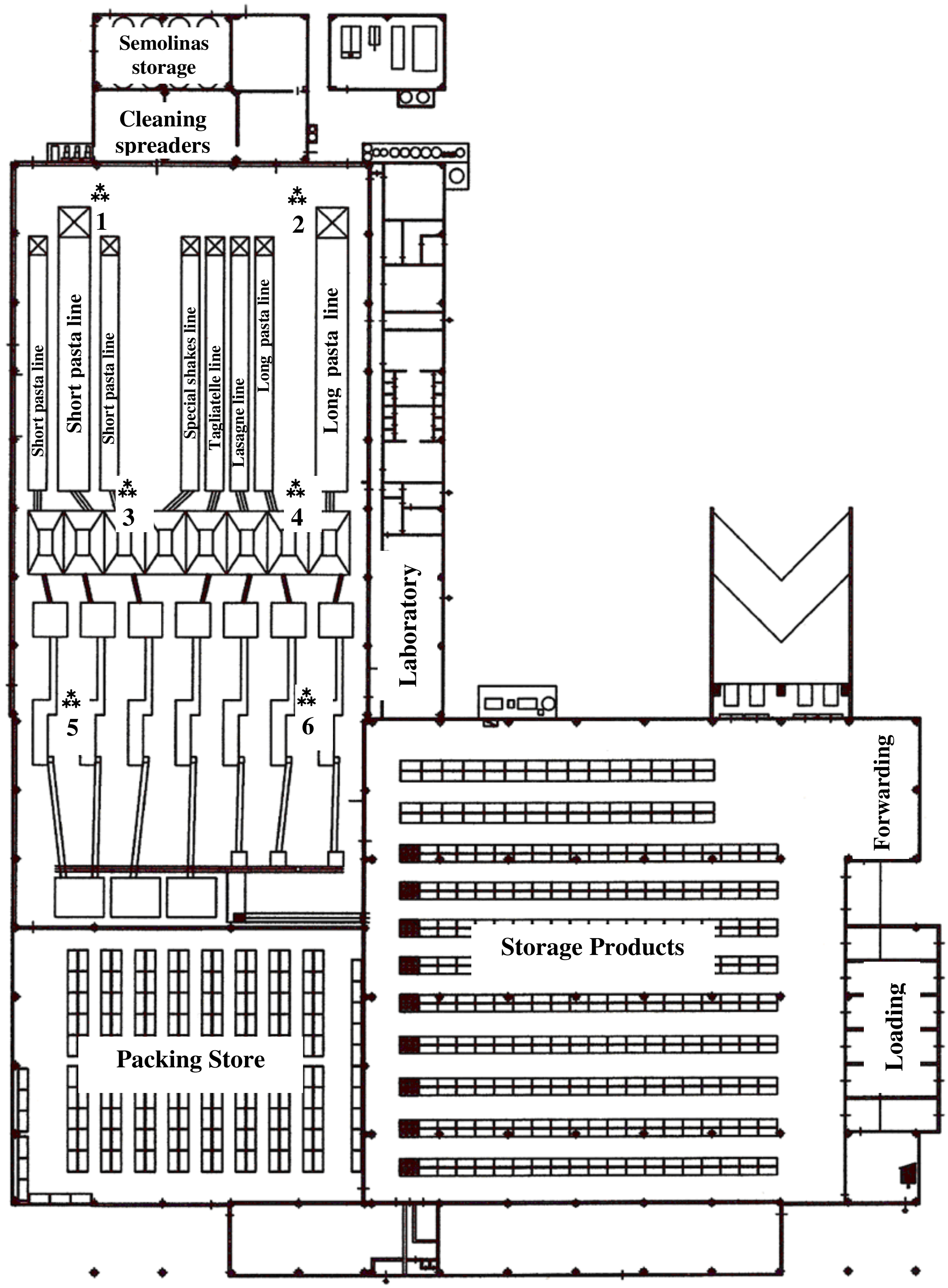

Figure 1. Schematic plan of the studied pasta factory; the symbols (⁂) indicate the noise and dust fixed sample points. Image is not drawn to scale.

Results
Evaluation of noise risk

The Italian laws and Reg. EC 2003/10 set the following limits:
Exposure limit levels: respectively L_{EX},8h = 87 dB(A), L_{EX},ppeak = 140 dB(C);
Upper levels of action: respectively L_{EX},8h = 85 dB(A), L_{EX},ppeak =137 dB(C);
Lower levels of action: respectively L_{EX},8h = 80 dB(A), L_{EX},ppeak =112 dB(C).

The measurements carried out in the fixed sample points (tables 2 – 3 - 4) showed that exposure times of less than 8 hours give levels very similar to those obtained for 8 working hours, although almost always lower. In fact, the machines do not stop during the working day, and the continuous noise produced is practically constant. However, the situation we studied was at the limit when it came to defining the employer's obligations:

1. warning signs and delimitation of danger zones (in excess of the Upper level of action);
2. use of individual protective equipment (in excess of the Lower level of action) and obligation to wear it (in excess of the Upper level of action);
3. interventions on machinery, production processes and task organisation (in excess of the Exposure level limit)
4. training and information (in excess of the Lower level of action);
5. health monitoring (in excess of the Upper level of action).

In this specific case, the level 87 dB(A) (Exposure level limit on 8h) is exceeded at the beginning of the short pasta line only when measurements are carried out with the phonometer on for 8h; for shorter exposure times, the L_{EX}, τ_e are mostly between the Upper level of action on 8h (85 dB(A)) and Lower level of action on 8h (80 dB(A)) (table 2). Similar levels to these were also measured in the other sites on short pasta line, in the storage area (table 3) and in the packaging area (table 4).

The difference between the levels measured for 8h and the levels measured for shorter times are much less evident on the long pasta line. Here the maximum levels were always found in the press area, near to 80 dB(A); the levels of exposure measured at the other sites were always less than Lower level of action 8h (tables 3 - 4).

The impulse noise was generally lower than Lower level of action (112 dB(C)), and only the press area is subject to impulsive noises of 120 dB(C) (tables 2-3-4), which therefore do not reach the Upper level of action (137 dB(C)); high levels of impulsive noise were measured in this area for all exposure times (table 2). At the other sites where measurements were made, high levels were found of $L_{EX},ppeak$ for exposure times of less than 8 h (tables 2-3).

It is evident that in this type of working situation, the choice of the time period for measuring noise levels is of fundamental importance to obtain levels which once integrated onto the exposure time according to (2), then effectively correspond with the noise exposure during the entire working day; the choice of relatively short exposure times is frequent for professionals in this sector, but does not mean exclude the possibility of taking measurements over longer time periods if the levels are found to be near the limits.

The presses area is the noisiest area, because these machines are used for a great many operations (feeding, kneading, extrusion die and cutting) creating acoustic pressure which tends to add up; the noise of the short pasta line is accentuated by the "shaker pre-dryer" where the mechanical stress of the vibrating parts tends to increase the continuous component of the acoustic pressure. In the area where the dough is prepared and extruded, there is a greater discrepancy between the levels found for 8h and those obtained with shorter exposure times, especially for the short pasta (table 2); therefore the noise caused by the presses and the pre-dryers is more variable than the noise created by the packaging machinery (tables 3 – 4), and requires longer times for measuring exposure levels.

For this reason, the very careful maintenance is necessary for the machinery in this part of the line, especially for the short pasta, so as to keep the noise levels under control, because these tend to exceed the Lower levels of action.

The impulsive component of environmental noise examined does not seem to be influenced by the time period used for measurement, nor by the continuous noise produced by the machines. High levels were measured for short periods of time which were not found at the same place for longer periods; in addition, high levels were found at the sites on the long pasta line in different places from the presses, where the highest levels of continuous noise are produced. These peak levels can be attributed to occasional factors connected with task organisation and machine maintenance.

For example, the movement of boxes, the vacuum pumps, the machines which recovery and grind scraps, the fans in the dryers are all stages in the production process where correct personnel and machines management can reduce the risks from impulsive noise. These machines can function discontinuously - and like many sources of impulse noise – do not have much influence if the system is sufficiently insulated. So it is important to check the apertures of the compartments containing this machinery, and make sure that lubrification and periodic cleaning are carried out, and that the machinery is correctly used, in order to prevent occasional cavitation.

Table 2. Values of equivalent (LAeq,Te) and impulsive (L_{EX},ppeak) noise levels measured in the noise sample points of the machines area: sample point 1 near short pasta line; sample point 2 near long pasta line (Figure 1).

Noise levels	**Te = 8 h 1) short pasta**	**Te = 8 h 2) long pasta**	**Te = 2 h 1) short pasta**	**Te = 2 h 2) long pasta**	**Te = 47 min 1) short pasta**	**Te = 47 min 2) long pasta**
LAeq,Te (dB(A))	90.1 = L_{EX},8h	81.9 = L_{EX},8h	85.5	82.5	84.7	81.9
L_{EX},ppeak (dB(C))	121.1	129.2	121.2	104.9	123.1	118.3

Table 3. Values of equivalent (LAeq,Te) and impulsive (L_{EX},ppeak) noise levels measured in the noise sample points between drier and silo: sample point 3 near short pasta line; sample point 4 near long pasta line (Figure 1).

Noise levels	**Te = 8 h 3) short pasta**	**Te = 8 h 4) long pasta**	**Te = 2 h 3) short pasta**	**Te = 2 h 4) long pasta**	**Te = 47 min 3) short pasta**	**Te = 47 min 4) long pasta**
LAeq,Te (dB(A))	83.5 = L_{EX},8h	77.2 = L_{EX},8h	81.9	77.5	80.2	76.8
L_{EX},ppeak (dB(C))	104.9	110.2	110.0	106.4	118.8	121.7

Table 4. Values of equivalent (LAeq,Te) and impulsive (L_{EX},ppeak) noise levels measured in the noise sample points of the packaging area: sample point 5 near short pasta line; sample point 6 near long pasta line (Figure 1).

Noise levels	**Te = 8 h 5) short pasta**	**Te = 8 h 6) long pasta**	**Te = 2 h 5) short pasta**	**Te = 2 h 6) long pasta**	**Te = 47 min 5) short pasta**	**Te = 47 min 6) long pasta**
LAeq,Te (dB(A))	83.2 = L_{EX},8h	76.0 = L_{EX},8h	82.2	75.8	80.5	77.2
L_{EX},ppeak (dB(C))	104.9	108.7	108.7	106.4	121.2	116.5

Dosimeter readings may be useful to check the levels of personal exposure to which workers are subjected. However, the dosimeter data (tables 5 – 6) far exceed the limits allowed and diverge noticeably from the data obtained from readings at fixed sites, and therefore must be interpreted correctly.

Table 5. Values of equivalent noise levels (LAeq,Te), daily noise levels (L_{EX},8h) and impulsive noise levels (L_{EX},ppeak) measured with personal dosimeters worn by four operators of the machines area (Figure 1).

OPERATOR	LAeq,8h = L_{EX},8h (dB(A))	L_{EX},ppeak (dB(C))	LAeq,Te (dB(A))	L_{EX},ppeak (dB(C))	L_{EX},8h (dB(A))
1 Machine operator	92.0	132.2 (Te = 8 h)	93.6 (Te=46min)	137,4 (Te=46min)	91.3
2 Machine operator	91.5	133.8 (Te = 8 h)	92.8 (Te=47min)	138.2 (Te=47min)	90.8
3 Machine operator	94.1	128.9 (Te = 8 h)	96.2 (Te=38min)	130.6 (Te=38min)	93.3
4 Electrician	93.4	138.3 (Te = 8 h)	95.2 (Te=38min)	142,5 (Te=38min)	92.4

Table 6. Values of equivalent noise levels (LAeq,Te), daily noise levels (L_{EX},8h) and impulsive noise levels (L_{EX},ppeak) measured with personal dosimeters worn by four operators of the silage/pakcaging area (Figure 1).

OPERATOR	LAeq,8h = L_{EX},8h (dB(A))	L_{EX},ppeak (dB(C))	LAeq,Te (dB(A))	L_{EX},ppeak (dB(C))	L_{EX},8h (dB(A))
1 Pakcaging operator	86.7	127.5 (T_e=8h)	89.0 (T_e=40min)	137.4 (T_e=40min)	86.0
2 Pakcaging operator	86.8	115.7 (T_e=8h)	89.3 (T_e=52min)	123.2 (T_e=52min)	86.4
3 Pakcaging operator	86.1	119.7 (T_e=8h)	88.6 (T_e=57min)	137.2 (T_e=57min)	85.8
4 Pakcaging operator	88.1	120.3 (T_e=8h)	90.1 (T_e=40min)	126.8 (T_e=40min)	87.8

The readings obtained with dosimeters confirmed that the workers who operate in the presses area (table 5) are subject to a higher daily exposure level than the people working in the storage/packaging area (table 6). Also, the levels obtained with readings extended to 8h are higher, although still comparable, with the L_{EX},8h obtained with shorter exposure times. However, it is evident that the workers are nearer to the machinery, and therefore subject to more noise than the data collection sites. The readings obtained from the fixed sites are more indicative of the environmental noise.

On the other hand, the difference between phonometer and dosimeter data imposes the following consideration. Independently of the fact that the dosimeters are or are not Class I, in many cases the equipment for taking personal readings cannot be controlled by the researchers, or by the workers who wear it. For reasons of comfort or the demands of their work, workers are often forced to move in such a way as to stress the microphones in a different way from acoustic pressure. So in this specific case, the noise levels which are most indicative of the situation in the factory are those registered by the phonometers, also because anomalous behaviour by workers cannot influence these levels. The consequence is that in these factories, evaluation of noise risk must always be carried out by comparing personal readings with readings from fixed sites.

Evaluation of dust risk

The readings of PM10 concentration in the air, carried out by the samplers, are shown in table 7. We can see a positive situation, since the levels of PM10 at every site are much lower than 0,5 mg/m^3, level given by the ACGIH, that is to say the maximum concentration allowed, weighted in the time of 8h (TLV-TWA). To this concentration of total dust, almost all the workers may be repeatedly exposed, without harmful effects due to the flour dust.

This is to related to the efficiency of the extractor fan system, which does not allow the dust to deposit on the floor, intervening rapidly to reduce the risk for the workers on the dust way towards the air outlets. In fact, peaks of dust production are measured for very short periods of time, about 5 min, which do not in any case exceed the TLV-TWA and are reduced to lower levels in equally short periods (figure 2).

Table 7. PM10 concentration in air measured by fixed samplers taken in the three investigated working areas.

TLV - TWA	Sample point number (figure 1)					
	1 (Presses Short pasta)	2 (Presses Long pasta)	3 (Drier/silo Short pasta)	4 (Drier/silo Long pasta)	5 (Packaging Short pasta)	6 (Packaging Long pasta)
0.5 mg/m^3	0,005 mg/m^3	0,002 mg/m^3	0,005 mg/m^3	0,002 mg/m^3	0,004 mg/m^3	0,006 mg/m^3

Relatively greater production of PM10 takes place in the packaging area, where there are higher levels on the long pasta line; it is evident that more dust is produced when working with the dry product. Indeed, the start of the packaging line is an "open section" of the system; the product emerges from the drying and storage tunnel (figure 1), where dust accumulates because the space is confined and insulated up until the outlet section. On the long pasta lines, the product also needs to be laid flat and cut before packaging; this creates more dust and scraps, which are shredded and then recycled at the head of the system.

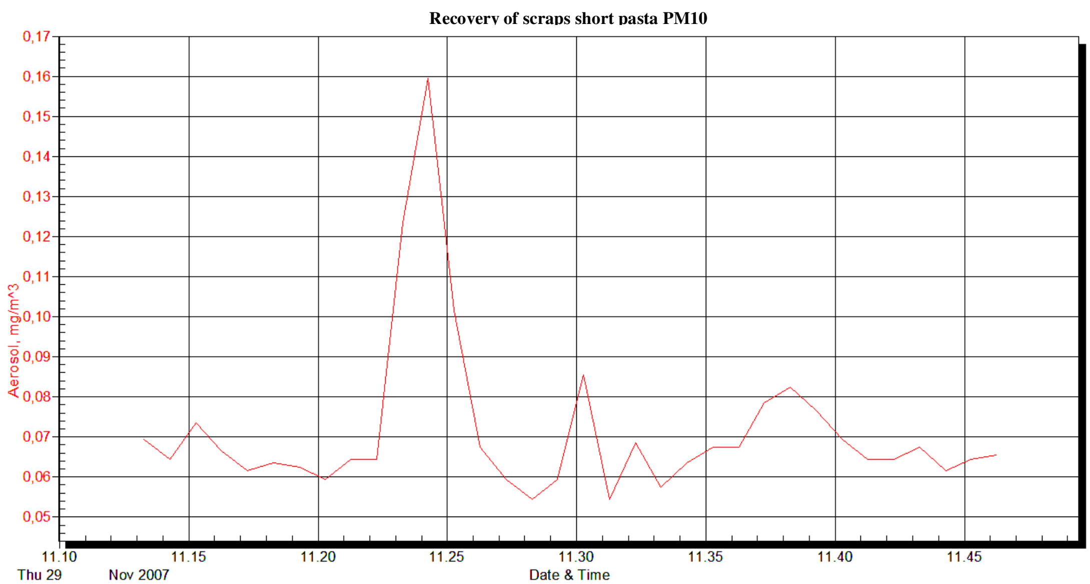

Figure 2. Example of measurement of PM10 concentration in air versus time, by direct-read dust analyser, taken in the sample point 3 between drier and silo of short pasta line (Figure 1).

Finally, we must consider that packaging involves some complex operations, like the preparation and filling of the packages and transport by mechanical equipment in constant movement, as well as grinding and pneumatic conveyance of the contents of failed packages.

However, in this kind of food production, periodic monitoring of factory dust must be carried out in order to check the efficiency of the extractor systems and to avoid risks of allergies caused by dust inhalation. It is important to check the workers' breathing, and in cases where there are workers with flour asthma, to evaluate the different factors which can influence the course of the illness. In fact, it should be said that exposure to respirable semolina dust is an allergy risk factor even at levels of much less than TLW, due to a particular subjective proneness: recent studies indicate that exposure to wheat flour sensitises 11.5% of subjects, and causes respiratory problems in 12÷18,5% and work-related asthma in 5÷7% (Becklake M. et al. 1997; Benvenuti F. et al. 1998).

Conclusions

The PROGESA Department and the Department of Internal and Public Health have been carrying out a research programme for several years which aims to provide guidelines for evaluation of risks in workplaces in the livestock farming and food sectors. An inter-disciplinary approach is needed to evaluate risks to workers' health and safety in their workplaces, bringing together the results of research in different sectors. In addition, the risk factors are influenced by numerous variables, which are difficult to control because they depend on both technical and human factors. Moreover, the results obtained in the laboratory must, in any case, be checked with trials carried out in the workplace – without interference, damage or changes to the firm's production cycle.

Finally, the solutions proposed must relate to the economic situation of the firms, knowing that in some cases it is difficult - or even impossible - to remove every risk. The technicians who are responsible for various levels of prevention are also asked to achieve partial objectives, at the best cost (which does not always coincide with the lowest cost) and maximum benefit.

The results of the research carried out in the present work confirm the validity of the general considerations stated above, for the pasta sector of the food industry, also in the light of the complex legal requirements.

There was a problem concerning methodology and approach in the evaluation of noise risk, because this work involved noise levels at the limits of what the law allows. It was evident that correct definition of legal requirements and evaluation of effective exposure to noise required phonometer readings taken at fixed sample points and also dosimeter readings from individual workers; the former for dealing with the production cycle and machinery, and the latter for task management. If the results are read without taking into account the reality of the situation, they can appear incongruent and worrying; but they allow us to state that, in this factories, the management of this kind of risk factor requires the employer to carry out continuous monitoring of the environmental data, maintenance and turn-over of the machinery and systems, and continuous personnel training and appropriate assignment of tasks.

A similar commitment is necessary to manage the risks deriving from exposure to dust particles. In this kind of firm this risk factor is low, and is caused by machines and stages in the production cycle which do not produce high noise. On the other hand, the efficiency of the air extractor system is fundamentally important, because it is possible for workers to develop respiratory diseases caused by allergic reactions to semolina dust.

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