Welfare, health and productive performances of growing-fattening pigs for production of typical Italian hams

Matteo Barbari
Department of Agricultural and Forestry Engineering, University of Firenze, Italy
e-mail: barbari@unifi.it

ABSTRACT

A preliminary survey carried out in an area of the North of Italy allowed to describe the structural and managerial characteristics of 40 farms for production of typical Italian heavy pigs. Nine pig farms were selected for execution of the experimental trials: 5 farms with only the growing-fattening phases; 4 farms with the whole productive cycle. In these farms analyses were carried out to evaluate environmental conditions in the breeding facilities ("environmental diagnosis"). It was possible to identify the houses with a high hazard for health and/or welfare of pigs. Subsequently a detailed survey was executed, concerning the following parameters. a) *Productive performances*. b) *Microclimatic conditions*. c) *Behaviour patterns*. d) *Health state*.

After the data elaboration phase, solutions for improving animal welfare were suggested for the different houses. Such solutions concern different aspects: structures, equipment, feed distribution systems, management, etc. After the adoption of the advised solutions by the pig breeders, a new survey will be carried out in the different houses, in order to verify the effectiveness in real situations. On the basis of this study a guide for the technicians of the extension services will be produced, in which the useful solutions for improving animal welfare will be described.

INTRODUCTION

It is common knowledge that the concept of "animal welfare" can be considered from different points of view. For the breeder the quantity parameters are the most important to evaluate the welfare according to the productive and reproductive performances. This includes of course the need of keeping animals in good health condition (satisfactory health state, no body lesions). From a different point of view ethologists suggest to evaluate welfare on the basis of possible behavioural changes by the animal not in the natural environment within a new environment (daily rates, movements, integrity of functions). Lastly, from the physiologists point of view possible changes in the neuroendocrine reactions of the animal must be analysed on the basis of hormonal parameters. We think that only an exhaustive global analysis of the problem in which all the elements are taken into consideration can offer a correct evaluation of animal welfare and indirectly give a suggestion of the proper breeding technique to use.

The fundamental requirements for animal welfare consist in proper breeding systems, which consider the health state and the behavioural needs of animals and at the same time allow the breeder high standard. It is necessary to define precise reference parameters which on the basis of ethological and zoothecnical studies allow to identify a condition of better welfare for pigs without compromising the productivity of a farm. On the other hand the best productivity (that is the increase of weight per day and the feed conversion rate) often reflects suitable microclimatic and feeding conditions, as well as the absence of pathological diseases.

MATERIALS AND METHODS

The study is carried out within a research project financed by Emilia Romagna Region. This project is devised into 7 different actions, one of which concerns the analysis of fattening pig farms: "study of the relation between welfare, health state and productive performances during post-weaning, growing and fattening phases of pig farms for production of typical Italian hams".

The aim of the action is to identify the relations between the different breeding systems and housing typologies and the welfare of pigs bred in the different phases of the productive cycle, checked trough the analysis of productive, behavioural and health indicators.

The first phase of the research is a preliminary survey on pig farms in Province of Modena to obtain a wide and precise range of the housing solutions used in the post-weaning, growing and fattening phases as concerns their structural and managerial characteristics.

The technicians of Breeding Association using a questionnaire made an inspection in 40 selected farms divided in the following way: 15 farms with only the growing-fattening phases; 25 farms with the whole productive cycle.

At the end of the research the data obtained were loaded into a data-base. It was possible to make first evaluation of the farms obviously considering all the information obtained from the preliminary schedules and the needs of renovation of the buildings considered during the first inspection.

Nine farms were selected; they were divided according their productive function: 5 fattening pig farms; 4 closed-cycle pig farms. The 5 fattening pig farms are connected with a diary factory to use the whey for the pigs feeding.

The inspected farms are marked by initial. Tab. 1 shows a list of the farms with their main characteristics.

Before carrying out 3 different surveys, a preliminary inspection aimed to identify the unsuitable buildings for the animals comfort took place. We can therefore consider the following stages:

a. Preliminary inspection
b. Survey of behavioural and microclimatic parameters
c. Anamnesis of the farm and serologic check
d. Evaluation of a lot of pigs at slaughtering

During the inspections we made an evaluation of the environment, using a "environmental diagnosis" schedule. It collects different information about the environment, with some immediate measures (temperature, air humidity, air velocity, ammonia concentration, fans capacity). The collected information allow to make the energy balance of the building and to check the suitability of the performance of the insulating materials, the correct dimensions of heating and cooling equipment, the efficiency of the change of air in different seasons. It was possible to identify the buildings with bigger problems connected to the health state and the animals welfare.

Later the breeders willingness to execute the surveys of the project in the risk buildings was verified.

The structure of the checked building can be summarized in following way. In the fattening pig farms two types with pigs in the final phase of the cycle in a pen with full concrete floor and liquid feeding were considered (F1, F2); two types with growing pigs in a full concrete

floor and liquid feeding were considered (G1, G2); one type with growing pig in a pen with full concrete floor and dry feeding (G3).

In the four close-cycle farms four types with the pigs in the first growing phase (from 15-20 kg to 30-35 kg) were examined, but with different floor systems (slatted concrete floor: W1, W2; metallic slats: W3, W4) and feeding and with different systems of environmental control.

Tab.1: Main characteristics of the examined buildings.

Farm	*Phase*	*Housing system*	*Feeding*	*Ventilation system*
W 1	Post-weaning 15 - 30 kg	Totally slatted floor (concrete)	Dry feeding - *ad libitum*	Natural - transversal
W 2	Post-weaning 15 - 30 kg	Totally slatted floor (concrete)	Dry feeding - *ad libitum*	Artificial - extraction
W 3	Post-weaning 15 - 30 kg	Totally slatted floor (metal)	Dry feeding - *ad libitum*	Artificial - extraction
W 4	Post-weaning 15 - 30 kg	Totally slatted floor (metal)	Dry feeding - *ad libitum*	Natural - transversal
G 1	Growing 30 - 100 kg	Full concrete floor – outside slatted dunging passage	Liquid feeding - rationed	Natural – from ridge
G 2	Growing 30 - 100 kg	Full concrete floor – outside slatted dunging passage	Liquid feeding - rationed	Natural - from ridge
G 3	Growing 30 - 100 kg	Full concrete floor – outside slatted dunging passage	Dry feeding - rationed	Natural - from ridge
F 1	Fattening 100 - 160	Full concrete floor – outside slatted dunging passage	Liquid feeding - rationed	Natural - from ridge
F 2	Fattening 100 - 160	Full concrete floor – outside full dunging passage	Liquid feeding - rationed	Natural - from ridge

Survey of the microclimatic and behaviour parameters

The tests were carried out in the spring-summer period (from March to June, 2000). The surveys of the microclimatic parameters were carried out at the same time as the surveys of the behavioural data. In three cases the survey of the microclimatic data was repeated in winter as it was absolutely necessary to make a test during the cold climate conditions to identify the most suitable interventions to suggest breeders.

To obtain the microclimatic data a data-logger was installed able to find out air temperature, radiant temperature, air velocity, relative humidity. These data were recorded both inside the building in different places and outside. At the end of the survey these data were loaded onto a PC in order to be processed.

The collection of the behavioural data was effected using a closed circuit television set, with time-lapse video tape recorders.Since it was impossible to identify pigs separately in the growing-fattening phases, the survey was based on group behaviours. The behaviour was divided in two main categories: resting and activity.

The resting behaviour includes also the “sitting dog” position, which is really not very frequent. The resting and activity periods were furthermore divided into time bands of two hours and precisely from 0 to 2, from 2 to 4, from 4 to 6, and so on.

The activity period was then divided into two items:

- feeding time or time at the feeder or trough;
- different activities, including time for moving, defecation, drinking and play.

We also considered the aggressive behaviours: fights, cannibalism events, and so on. Fights and aggressive behaviours are not expressed in time but number.

It is not easy to give a definition of aggressive behaviour. For our purposes we considered only the contacts among pigs, which cause a reaction, for example when a pig is forced to stand up or to react. Some behaviours such as rubbing, striking snout against other pigs, own place defence at trough or drinker. Only violent struggles were recorded. Also bad habits, slips on the floor and other interesting aspects were taken into considerations.

Collection of productive data

In some cases it was possible to collect some productive data (feed consumption, daily increase per day, feed conversion rate), obtained directly from the trial group during the survey period of environmental and behavioural data. In this paper we leave out the evaluation of the productive data for reason of space.

Collection of health data

To evaluate the animal welfare in pig farms it is important to keep in great consideration the health condition of each pig inside the farm and consequently the farm in its entirety. During the period from March to August 2000, some technicians of Breeding Association carried out health tests in the farms of the project. Before the serologic check an anamnesis phase took place to identify the epidemiological aspects of diseases (e.g. morbidity, mortality, condition of spreading, etc.), main clinical aspects, therapeutic and prophylactic interventions and relevant results. For this purpose we used a proper schedule.

The serologic evaluation is used mainly for the diagnosis of respiratory syndromes very common in modern pig farms. In each farm two groups of 16 animals were identified, one with pigs of 2 to 4 months and one from 6 to 8 months. From these animals a bloody sample from the jugular vein was taken. The bloody sample were brought to an official analysis laboratory where the analysis for Aujeszky disease, *Mycoplasma Hyopneumoniae*, PRRS were made.

These tests were followed in some cases by post-mortem examinations on dead pigs to find significant pathologic conditions present in the farm. In each farm a lot of animals was slaughtered to find the presence or the incidence of anotomo-pathological lesions, caused by environment conditioned diseases or by other elements in the farm. The numerical entity of the observed lots varied greatly according to the dimensions of the farm (from 20 to 150 heads).

For each carcass we pointed out: presence, gravity and incidence of skin lesions by ectoparasites or others; presence, gravity and incidence of pleurisies; presence, gravity and incidence of pulmonary tissue suffering from pneumonia; presence of pulmonary lesions of the “miko-like” type; presence of hepatic lesions (“spot lesions” caused mainly by endoparasites); presence of abscesses.

RESULTS

Analysis of the farm and energy balance

The availability of space was tested in each building as well as the observance of the current regulations. The data are summarized in tab.2. We can notice that not always the minimum

surface indicated in the law is respected. In some cases the law is respected only thanks to outside dunging passages, added to the inside surfaces.

Tab. 2: Surfaces assigned to pigs to the examined buildings (D.Lgs. 534/92 is the Italian implementation of Directive 92/630/EC laying down minimum standards fro the protection of pigs).

Farm	*Head / pen*	*Weight (test) kg*	*Surface / head m^2*	*Observance D.Lgs. 534/91*
W1	30	35	0,30	NO
W2	40	17	0,46	YES
W3	24	20	0,28	NO
W4	25	20	0,36	YES
G1	25	60	1,40	YES
G2	42	30	0,71	YES
G3	65	60	0,72	YES
F1	20	120	0,97	NO
F2	38	130	1,03	YES

Tab. 3: Energy balance, medium K and dimensions of the ventilation openings in the examined buildings

Farm	*Energy balance W*	*Medium K (walls and covering) W/m^2 °C*	*Accordance to maximum ventilation*	*Outlet openings summer (theoretic / actual) %*	*Inlet openings summer (theoretic / actual) %*	*Theoretic ventilation / actual ventilation summer %*
W1	- 16595	1.54	NO	14.6	14.6	-
W2	- 4857	1.84	-	-	-	272.4
W3	- 1331	1.16	-	-	-	Non meas.
W4	- 22416	1.94	NO	32.3	32.3	-
G1	- 88130	2.59	NO	89.0	62.0	-
G2	- 25963	1.07	NO	70.0	18.2	-
G3	- 59961	2.49	NO	56.9	51.7	-
F1	- 7405	2.14	NO	77.4	8.5	-
F2	- 64842	2.17	NO	45.5	5.4	-

The check of the energy balance was made in all farms of the project at the end of the first phase of the survey to define very precisely how to improve the welfare condition. The main data are listed in tab.3.

The main aim of the calculation was to test the degree of insulation of the buildings under observation and then to find possible lacks in thermal insulation or in the heating system (if present). In all buildings an energy deficit caused mainly by the poor insulation level was recorded. The value the medium K is in face generally high and in 4 cases is over 2 W/m^2 °C.

This calculation was very important to quantify the minimum and maximum air ventilation and to test the ventilation system (dimensions of the openings or artificial ventilation system). Also from this point of view there are planning lacks. In buildings with a natural ventilation there is often a great deficit of ventilation due to under-designing of the inlet openings and above all of the outlet openings. This deficiency is particularly worrying in summer. On the contrary when the artificial ventilation is used there is an excess of ventilation. The control systems of ventilation are scarcely used.

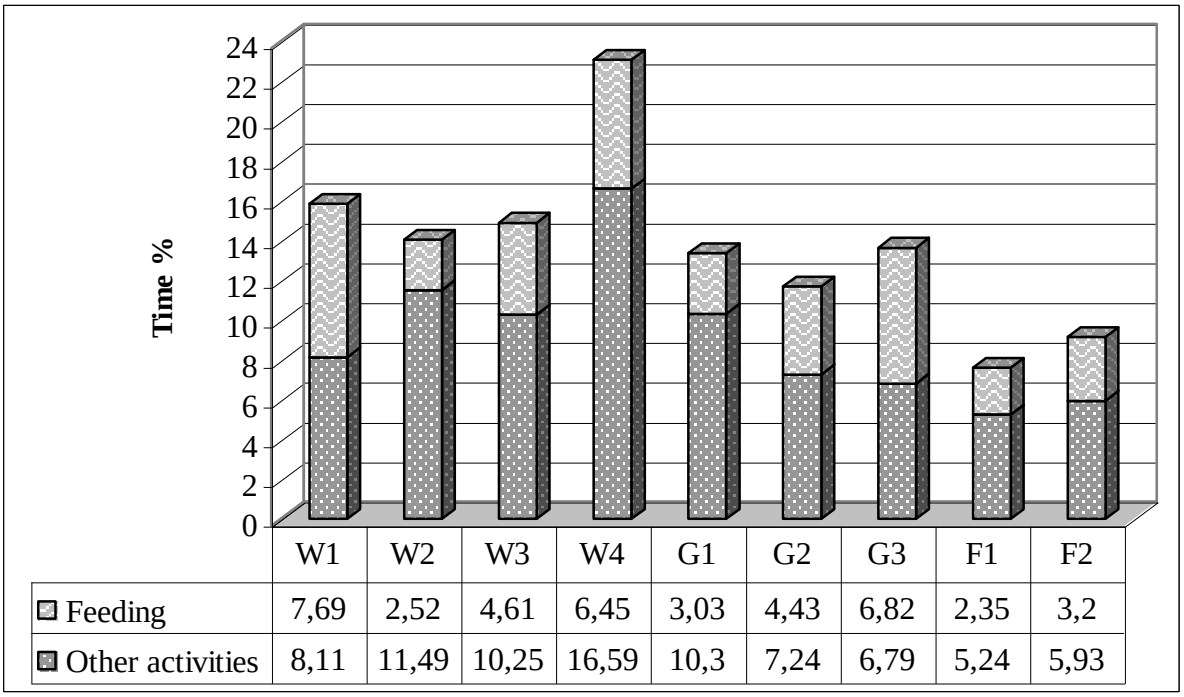
Behavioural data

From the behavioural survey we can notice interesting data, summarized in the following figures (fig.1, fig.2, fig.3, fig.4). Fig.1 compares the activity times in the 9 tested farms, divided into feeding times and times for other activities. Figures 2, 3 and 4 show the activity times in different buildings divided in time bands.

The analysis of behavioural data gave us the possibility to make important considerations about the pigs' welfare state. The figures show the most worrying situations which are characterized by very long or extremely low activity times. In farm W4, for example, we have long activity times, due to the great nervousness of pigs, for health problems which will be described later and for draughts on the animals.

On the opposite side we have farm F1 where the activity times are extremely low, owing to the short availability of space for the pigs which are in the final fattening phase. Analysing the figures we can clearly notice how the feeding system affects greatly the daily activity patterns.

No big problems of aggressiveness among animals was noticed, even if in some cases the short front of trough and the great number of pigs in the pen caused competition to reach the trough, decreasing the resting periods. Several situations of disturbance causing changes in the position were noticed (W1 in particular).



	W1	W2	W3	W4	G1	G2	G3	F1	F2
Feeding	7,69	2,52	4,61	6,45	3,03	4,43	6,82	2,35	3,2
Other activities	8,11	11,49	10,25	16,59	10,3	7,24	6,79	5,24	5,93

Fig.1: Daily activity times of pigs (%) in the different farms, divided into times for feeding and times for various activities (drinking, defecation, movements, play).

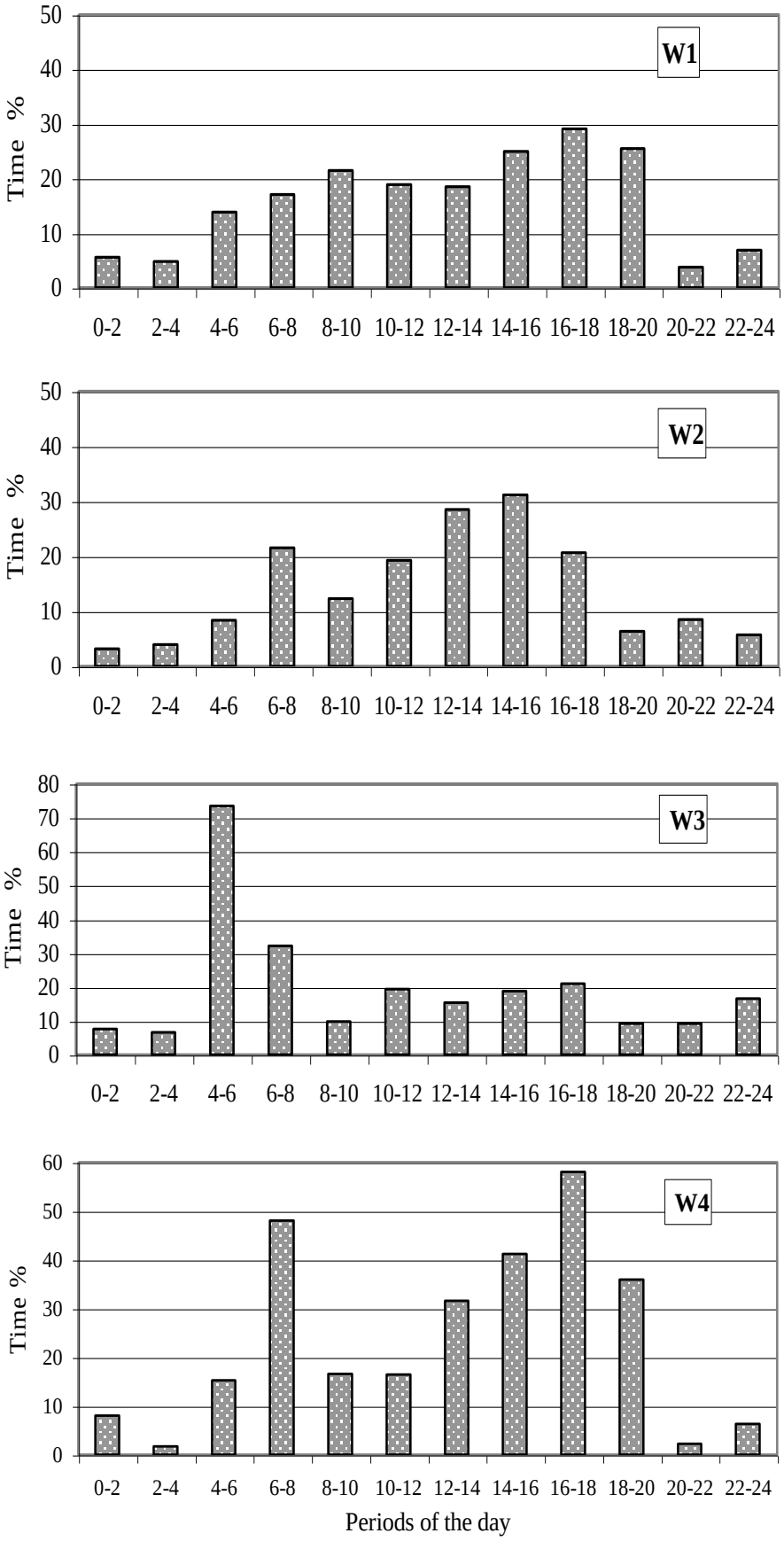


Fig. 2: Pigs' activities in post weaning phase, divided into time bands.

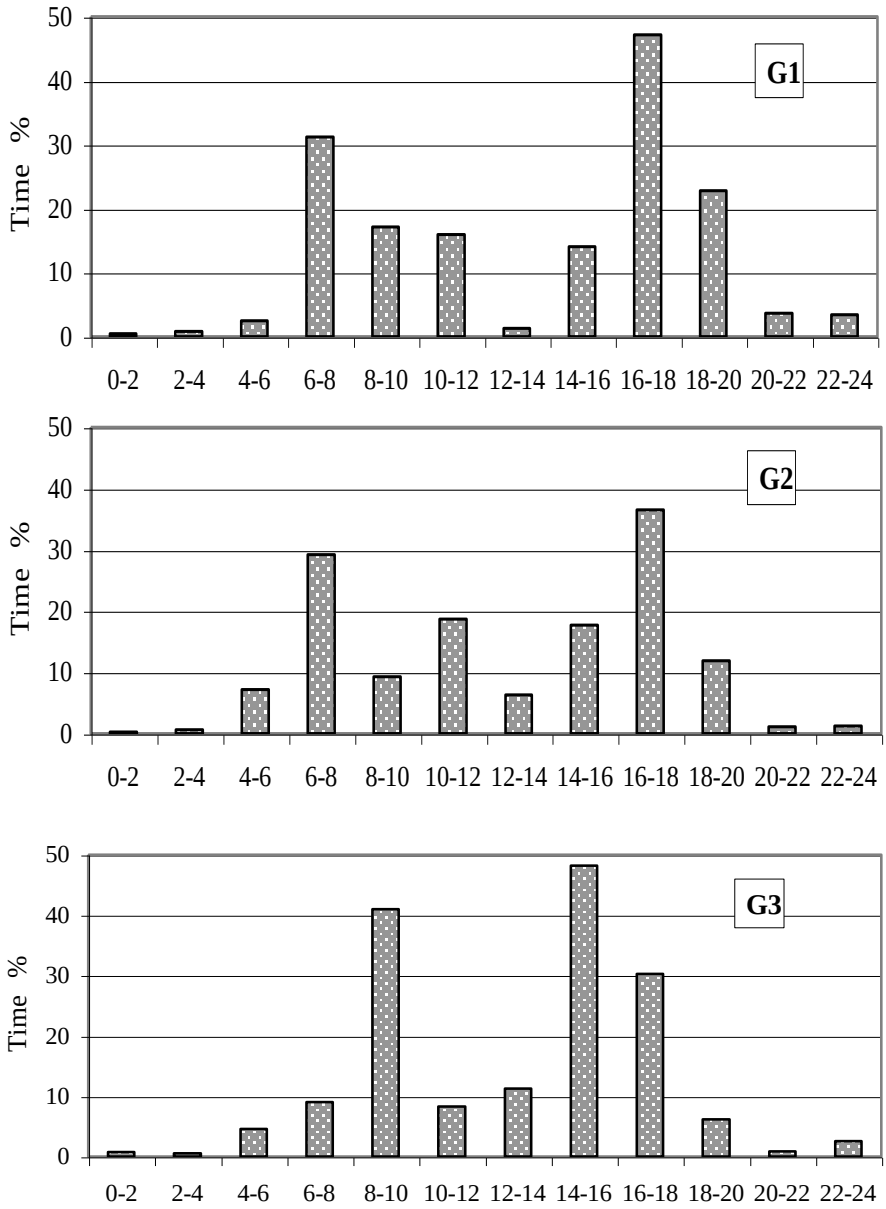


Fig. 3: Pigs' activities in growing phase, divided into time bands.

Microclimatic data

For reasons of short space we do not report figures with microclimatic data, but only a summarizing table showing the main aspects emerging in different buildings of the examined farms. It is advisable to remind for a right interpretation of the data that the period in question is spring-summer. In this situation we usually notice extremely high inside temperature, quite high relative humidity and with great daily excursions, high air velocity. The described problems are to be related to the insufficient insulation of the buildings, to the under-designing of outlet air openings, to the scarce ventilation control system.

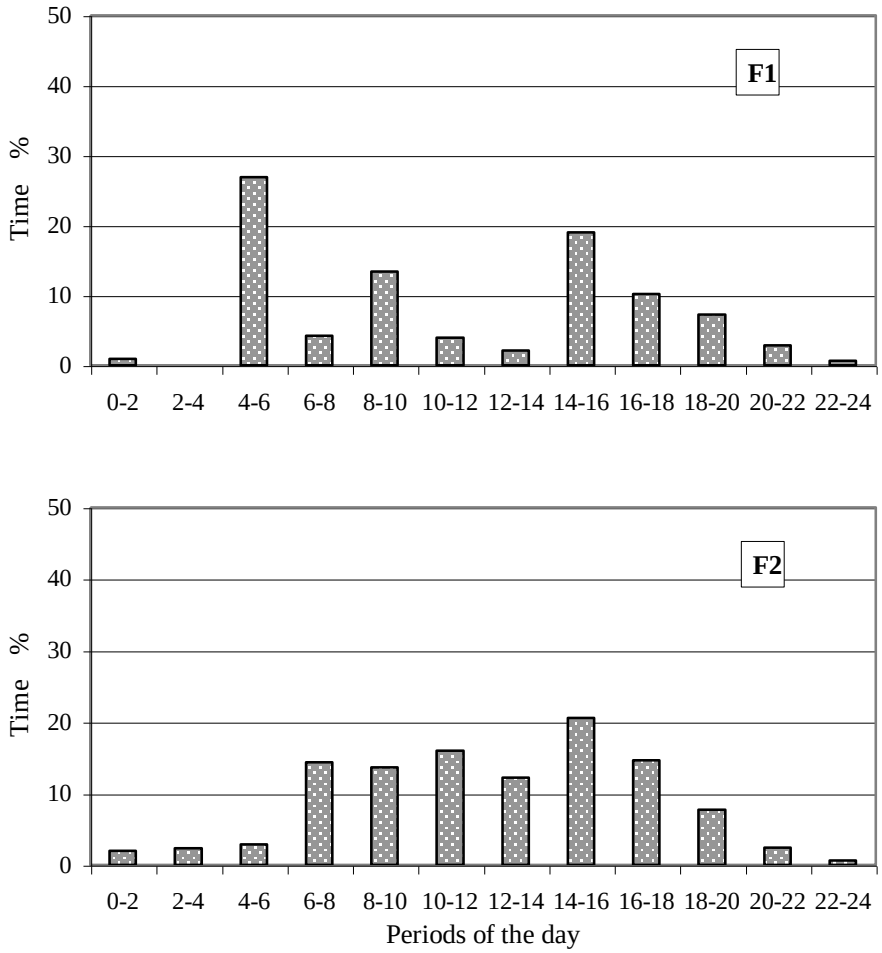


Fig. 4: Pigs' activities in fattening phase, divided into time bands.

Tab.4: Considerations on the microclimatic parameters obtained in the examined buildings.

Observed situations	**W 1**	**W 2**	**W 3**	**W 4**	**G 2**	**G 3**	**F 1**	**F 2**
Inside air temperature			✖			✖		
High air temperature excursions					✖			
Basically high RH	✖	✖						
Great RH excursions with high peaks			✖			✖	✖	✖
Variable air velocity with high peaks	✖	✖	✖	✖	✖			✖
High air velocity						✖		

Health data

Here we have a list of the data of the health surveys carried out in the farms more interested in the execution of the improvement interventions, owing to the great problems they have to face with in the farms. They are two close-cycle pig farms (W1 and W4) and two pig farms with only the fattening phase (G3 and F1).

Tab. 5: Health data of 4 pig farms.

Farm	*Found diseases*	*Serologic check*	*Monitoring at slaughtering*
W1	Pneumonias (particularly in winter season; 15-45 kg) due to *Mycoplasma Hyopneumoniae*; Enteric forms due to *E.coli* (20-40 kg)	No problems	*Parasitic forms* (Strongyloidosis e Ascaridiasis); hepatic compromising
W4	Frequent cough and beating breathing; loss of weight, emaciation, scrubby growth	Seropositiveness for *Mycoplasma hyopneumoniae* in all the 30 tested pigs	Slight presence of pleurisies and pneumonias of medium seriousness; quite high entity of presence and seriousness of hepatic lesions (“spot lesions”) due to larval migrations of parasites
G3	Pneumonias and pleuropneumonias (45 – 80 kg)	High instability in the group of heads from 6 to 8 months old for Aujeszky virus	Slight-good presence of pleurisies of medium seriousness
F1	Light respiratory syndromes of scarce seriousness. Red diarrhoea	High instability in the group of heads from 6 to 8 months old for Aujeszky virus	Slight – moderate presence of pleurisies and pneumonias of medium seriousness. Presence of skin lesions of slight or good seriousness related to mange (90% of animals)

In farm W1 we noticed a colibacillosis problem in pigs 20-40 kg weight. There are also pneumonias above all in autumn-winter, in pigs 15-45 kg weight. We noticed also a quite dangerous parasitic form, present in the whole farm, caused by large infestation of strongylids and round worms.

The monitoring during the slaughtering of 22 animals showed a quite high presence of pleurisies and especially dangerous hepatic compromising (“spot lesions”) for a large parasitic form caused by round worms.

In farm W4 since the post-weaning phase there are worrying phenomena of lack of homogeneity and difference among pigs with formation of swerves. They have a dangerous respiratory form, but no enteric problems. The clinical picture shows frequent cough and beating breathing; loss of weight, emaciation, scrubby growth.

Considering the seropositiveness for *Mycoplasma hyopneumoniae* in all the 30 tested pigs it was necessary to introduce the proper vaccine prophylaxis.

The monitoring during the slaughtering of 85 pigs, showed a slight presence of pleurisies and pneumonias of medium seriousness: slight good presence and seriousness of hepatic lesions ("spot lesions") for larval migrations of parasites.

In farm G3 the pigs show respiratory syndromes (pneumonias and pleuropneumonias) from 45 to 80 kg weight. The main clinical aspects are cough, beating breathing, especially during the dry feeding period; most of the pigs have big rings under the eyes, for a nasal phlogosis caused probably by an excess of dust.

The serological monitoring showed a great lack of stability in the group of pigs of 6-8 months for the *Aujeszky* virus. The monitoring during the slaughtering of 72 pigs showed a slight high presence of pleurisies of medium seriousness.

Finally in farm F1 slight respiratory syndromes, not worrying, were noticed. The main problem is the red diarrhoea which is the main cause of death, in fact a great number of dead pigs may occur each year (2-3% of reared pigs).

As in the previous farm, the serological monitoring showed a great lack of stability in the pigs from 6 to 8 months for the *Aujeszky* virus. In fact, almost all of them is gE-positive with high levels of total antibodies. This shows the clear and great circulation of the wild virus and/or the missing or not correctly submitted 3rd vaccine intervention at the age of six months.

DISCUSSION

On the basis of the information obtained during the phase of collecting and processing data it was possible to identify effective interventions for the tested farms.

To improve the welfare condition of the animals in pig farms different types of intervention are possible and can be shortly divided into 2 groups, that is structural projects and equipment projects. There could also be other interventions (e.g. managerial, health) which are not kept into consideration as they are outside the main aim of the research.

The main structural aspect are:

- proper planning of the farm (dimensions of the buildings, number of heads per room);
- animal density inside the pen;
- space at the trough or feeder;
- distribution parameters of the building;
- planning of the floor and type of floor;
- food distribution system;
- adoption of new solutions of housing (e.g. outdoor weaning with multiside system).

Among the main equipment aspects we can consider:

- improvement of ventilation;
- adoption of specific defence intervention against cold and heat;
- slurry evacuation systems able to improve the quality of the air inside the building.

Tab. 6 summarizes the interventions suggested to the breeders who are interested in adopting some of them.

In the second phase of the research which is developing during the drawing up of this paper, the efficiency of the adopted improvement interventions will be checked. For this aim the different types of survey made in the first phase of the research will be repeated

Tab. 6: Interventions proposed to breeders to improve the welfare conditions. (✖: suggested intervention; ✖✖: intervention considered absolutely necessary and pressing).

Proposal intervention	**W 1**	**W 2**	**W 3**	**W 4**	**G 1**	**G 2**	**G 3**	**F 1**	**F 2**
Reduction of number of heads/ pen	✖		✖✖					✖	✖
Improvement of insulation					✖✖		✖		✖
Installation and/or increasing of heating plant		✖		✖					
Increase of inlet and/or outlet air openings	✖✖				✖	✖✖	✖✖	✖✖	✖✖
Change in position of air ventilation openings		✖✖							
Use of an artificial ventilation system				✖✖					
Artificial ventilation system (summer assistance)						✖	✖	✖	✖
Reduction of air currents on the animals		✖	✖				✖		
Control of ventilation rate	✖	✖	✖	✖	✖	✖	✖	✖	✖
Rebuilding and/or maintenance of floor				✖		✖			✖
Improvement of hygienic-sanitary conditions				✖	✖	✖		✖	✖
Changes in number and position of drinkers	✖	✖		✖					
Increase of feeder space	✖		✖						
Dust control inside the building							✖		

CONCLUSIONS

The research allowed to identify a specific work methodology which can help the technicians who offer farms technical service to face with problems linked to animal welfare in a current way.

More efficient final comments could be made at the end of the second phase of the surveys, the one which will follow the execution of the interventions by the breeders. Actually, as no public contribution is given to carry out the interventions, not all the breeders will take the proposals into due consideration. Then, not all the breeders will execute the interventions following the fixed time and way. At the moment interventions in 4 of the 9 farms of the project are developing.

At the end of the second phase a guide for technicians who offer technical assistance will be drawn up in order to facilitate a timely and proper intervention in pig farms.

Acknowledgements
Many thanks to the technicians of Breeders Association of Modena for their contribution during the data collecting phase, in particular to Massimo Ricchi, Elisabetta Tecli, Laura Zerbinatti.