Recognised-by-law versus other identification systems in pigs: piglets discomfort evaluation and performance testing

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Abstract

The aim of the study was to evaluate the performance of recognised by Italian law (tattoos) and other (ear tags and injectable transponders) identification systems and to investigate if they caused different levels of short-term discomfort in piglets. Ninety-six ten-day-old piglets – equally assigned to four experimental groups – were identified with electronic ear tags (EET), transponders injected in the auricle base (TAB), in intraperitoneal position (TIP), or ear tattoo (T). Losses, breakages and readability of the identification devices were recorded to evaluate their efficiency. Forty-eight piglets were observed continuously for 5 min after identification. Behavioural indicators of pain, discomfort or ease were recorded in terms of duration of occurrence or frequency. Non-parametric analyses of variance were used to compare time required for the application of the devices and behavioural reactions of piglets. No healing problems or breakages of the electronic devices were observed during the trial. The readability after nine months was 93.8% for EET and TIP, 86.7% for TAB and 0% for T. The time required for the application differed significantly (P<0.001) among the four identification devices. EET and TIP showed better results than T considering losses, breakages, readability and time required for application. Behaviours most frequently recorded were head shaking and ear scratching, observed more frequently in piglets after the application of EET (P<0.001). The application of these identification devices caused a mild discomfort in piglets; further studies should investigate in detail the intensity and duration of reactions to the identification procedure.

Introduction

Conventional livestock identification systems are not efficient and present the inconveniences of breakages, losses, slow data recording and mistakes (Stärk et al., 1998), although in Italy tattoo is the preferred method for farmers and one of the compulsory system for the national law (Decree No. 200/2010). Electronic identification has been tested to verify permanency, cost, easiness of application, readability at working distance, showing good performance on farm and assuring full traceability (Madec et al., 2001). Few studies have considered the impact of identification procedures on animal welfare (Leslie et al., 2010). Electronic identifiers used in pigs include injectable transponders (Lambooij, 1992; Merks and Lambooij, 1990; Hernández-Jover et al., 2003) and transponders integrated in ear tags (Caja et al., 2003). The most suitable injection sites, in relation to transponder size, are the auricle base and the auricle. Results obtained in different experiments showed that injectable transponders in the intraperitoneal position are suitable too (Caja et al., 2005; Babot et al., 2006) and easily removable avoiding carcass contamination. One drawback related to the intraperitoneal site is the complexity of the injection itself, which requires specific training. The welfare of piglets could also be an issue of concern as the application procedure is considered risky for animals (Chiesa et al., 2003) and irritating. Moderate discomfort due to various handling and identification procedures may affect animal welfare negatively, however, no studies have evaluated this aspect in relation to identification procedures except for hot iron and caustic branding (DEFRA, 2003). The behaviour provides a substantial contribution to evaluate pain and disturbance in the animals: short-term pain causes a significant behavioural reaction (Broom and Johnson, 1993). In pigs, vocal responses (Marx et al., 2003; Puppe et al., 2005), intensity and duration of movements (Leidig et al., 2009), exploration and contact with the sow (Llamas Moya et al., 2008) were effectively used for the evaluation of discomfort experienced by piglets during manipulation and castration.

The aim of this study was to evaluate the performance of recognised by Italian law (tattoos) and other (ear tags and injectable transponders) identification systems and to investigate if they caused different levels of short-term discomfort in piglets.

Animals and experimental design

Ninety-six ten-day-old piglets were selected using a stratified randomization sampling technique from 24 different litters (four from each litter). Four experimental groups were created to compare different types of identification devices (one subject per litter per treatment): tattoos, electronic ear tags, transponders injected in intraperitoneal position or into the auricle base. Litters were housed with their dams in the same farrowing room consisting of 48 farrowing crates (L=235 cm, W=155 cm) at steady controlled temperature. The floor was partially slatted with a continuous heat pad at one side of the farrowing crate. Piglets could move freely around the pen and had access to a nipple drinker fitted in each pen. The identification of piglets was performed by a skilled operator in the farrowing room by drawing out each animal from his farrowing crate. The animals were handled in a calm and quiet manner by the same experienced handler and, after being marked with a coloured wax stick, were released into their own pen at the end of the application procedure. Handling was performed following the...
same method for all the groups and is described in the section Identification devices. The experimental protocol involved only common husbandry practices and was in compliance with the European Communities Council Directive of 24 November 1986 (No. 86/609/EEC). In order to limit anticipatory stress and to minimize the effect of familiarization, the experimenters never tested piglets in adjoining crates, but followed a test with another in a distant part of the farm and changed identification device according to a pre-determined sequence.

**Identification devices**

Electronic plastic ear tags (EET; 5.70 g, Ø 29.77 mm and h 24.25 mm; Haunper & Herberholz, Solingen, Germany) were applied to the right ear with the tagger pliers indicated by the manufacturer. The operator applied the ear tags with the piglets being held in the handler’s arms with the head uppermost.

Transponders (TAB; 12×2.12 mm; Planet ID, Essen, Germany) encapsulated in biocompatible glass were injected into the auricle base with an injection pistol (Planet ID) provided with a single-use 32×2.6 mm needle, wrapped in a sterilized pack. Before the implantation, the auricle base was disinfected with iodine solution (10% Provodone Iodine). For the injection, the handler restrained the piglet and the operator injected the transponder into the auricle base of the right ear in a dorso-ventral direction, according to the procedure described by Lambooij (1992).

Transponders (TIP; 23×2.7 mm; Datamars, Bedano-Lugano, Switzerland) encapsulated in biocompatible glass were injected in intraperitoneal position. The transponders were applied using a 35×3 mm single-use needle, wrapped in a sterilized pack. For this injection site, the implantation was performed by a skilled operator after disinfection with iodine solution. The injection and the restrain of animals were carried out according to Caja et al. (2005).

The selected electronic devices were Full Duplex-B (FDX-B) radio frequency technology in conformity with Standard No. 11785 of the International Standardization Office (ISO, 1996b) and from different manufacturers. Serial numbers of electronic devices agreed with ISO Standard No. 11784 (ISO, 1996a) and are included in the ICAR manufacturer codes (ICAR, 2009a).

The tattoo (T) consisted of an alphanumerical code (5 digits, 7 mm) and was applied by tattooing pliers on the right ear. Black spray ink was applied after the use of the specific tattooing pliers, to fix the code. The procedure was carried out with the piglets being held on a special metal cradle attached to a feeding trolley.

**On-farm performances**

Losses, breakages and readability of the identification devices were recorded to evaluate their efficiency during a nine-month period, up to slaughtering. Each electronic device was read at 10 cm distance with a handheld transceiver (i-max plus, Datamars, Bedano-Lugano, Switzerland) before and after the implantation, to verify the proper application and the functioning. After injection, piglets were checked for potential healing problems.

Reading performances on farm were evaluated one day after implantation, after a week, every month for 3 months, then at months 5

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**Table 1. Ethogram of the postures and main behaviours observed in piglets after identification.**

| Category          | Behaviour       | Definition                                           |
|-------------------|-----------------|------------------------------------------------------|
| Lying             | Lateral         | Body weight supported by side. Shoulder in contact with floor |
|                   | Ventral         | Body weight supported by belly. Sternum in contact with floor |
|                   | Extended forelegs | Lying on the stomach with the forelegs extended and the head lying on them |
|                   | Huddling        | Lying with at least three legs tucked under the body |
|                   | Isolated        | The pig lies on the floor without any physical contact to other pigs |
|                   | Near other piglets | The pig lies on the floor and is in physical contact with at least another pig |
|                   | Near the sow    | Lying in contact with the sow |
|                   | Trembling       | General shivering as if cold |
|                   | Scratching on littermates | Rubbing the body against other pigs |
| Sleeping          |                 | Recumbent in sleep with extreme muscular relaxation |
| Sitting           |                 | The pig sits on its tail with its forelegs stretched under its body |
| Standing          | Stiffness       | Rigid and insecure weight bearing |
|                   | Trembling       | General shivering as if cold |
|                   | Arched back     | Back is bent forming a round shape |
|                   | Wide apart legs | Standing with feet extended outside the main body frame |
|                   | Leaning against structures | Casting the weight to the structures for support |
|                   | Isolated        | Away from other pigs |
|                   | Scratching belly | Rubbing belly with hind leg |
| Gait              | Uniform         | Moving forward with regular steps |
|                   | Insecure        | Slowly moving forward with one leg at a time |
|                   | Not uniform     | Moving forward with irregular steps |
|                   | Lateral         | Moving with lateral steps |
|                   | In circle       | Moving along a circle |
| Eating            |                 | Eating creep feed |
| Udder stimulation and suckling |                 | Massaging the sow udder and suckling |
| Vocalization      | Shaking         | Uttering vocal sounds |
| Head position     |                 | Quick sudden movement of the head |
|                  | Relaxed         | Showing no auricular muscles tension |
|                  | Tense           | Showing auricular muscles tension |
|                  | Scratching      | Rubbing the ear with hind leg |
and 9 after application, with a handheld transceiver connected to a stick antenna (APR300, Agrident, Barsinghausen, Germany). The identity number of the tattoo was visually identified without restraining the animal, at the same reading times. The time required for the application of every device, from the immobilization of the animal to the end of the procedure, was recorded.

**Behavioural observations**

Two piglets per litter (n=48, 12 for each identification device) were selected from the sample, randomly chosen from all litters, for direct observations of short-term behavioural reactions following the application of the devices. Behavioural responses during the application were not recorded as piglets were restrained. Each piglet was observed continuously for 5 min, and its behaviour reported on a form. A total of 31 specific behavioural indicators of pain, discomfort or ease, selected in agreement with scientific references (Molony and Kent, 1997; Royal School of Veterinary Studies, 2004), were observed by a single trained observer and recorded (Table 1). Stages were reported in terms of duration in seconds and events (trembling or scratching on littermates while lying, trembling or scratching belly while standing, gait, eating, udder stimulation, vocalization, shaking or scratching head, ear position) as frequency of occurrence.

**Statistical analysis**

All the data were recorded on Excel files and statistically analyzed with SPSS 16.0 (SPSS, 2007). The performance of the four identification devices was evaluated comparing their losses, breakages and readability. The readability was calculated as the ratio between animal to the end of the procedure, was recorded. The transponders of two animals injected in the auricle base and one injected in the peritoneum were not read respectively 1 and 5 months after the application. At the end of the experiment, these subjects were slaughtered and transponders were not retrieved, hence they were considered lost. One ear tag was lost and retrieved in the pen 5 months after application. At the end of the experiment, the readability (Table 2) was 93.8% for both EET and TIP, 86.7% for TAB, and no tattoo was readable as the growth of the ear and the scratch of the skin prevented a clear identification of digits. Registered performances would be considered acceptable for the International Committee for Animal Recording Guidelines (ICAR, 2005, 2009b), that set the retention rate at 99%, only up to the third month after application for electronic ear tag and intraperitoneal transponder; however, generalisation of results is subject to limitations due to a relatively small sample size. The application of the ear tag is a rather simple operation and can be done by the farmer without risks for the animal. In literature, Stärk et al. (1998) and, recently, Prola et al. (2010) reported a readability of 100% for electronic ear tags in pigs; in contrast, Babot et al. (2006) obtained a similar readability (96.7%) to the one observed in our trial. The reading shows a percentage of error of 0.1%, however, problems may arise as ear tags are subject to a high loss rate, up to 40% (Caja et al., 2004). Different performances could be explained by technical characteristics of ear tags (weight, shape, materials, etc.) that influ-

**Results and discussion**

**On-farm reading and time of application**

Losses, breakages and readability were analysed and compared between the different identification devices. No breakages of the electronic devices occurred during the trial. The transponders of two animals injected in the auricle base and one injected in the peritoneum were not read respectively 1 and 5 months after the application. At the end of the experiment, these subjects were slaughtered and transponders were not retrieved, hence they were considered lost. One ear tag was lost and retrieved in the pen 5 months after application. At the end of the experiment, the readability (Table 2) was 93.8% for both EET and TIP, 86.7% for TAB, and no tattoo was readable as the growth of the ear and the scratch of the skin prevented a clear identification of digits. Registered performances would be considered acceptable for the International Committee for Animal Recording Guidelines (ICAR, 2005, 2009b), that set the retention rate at 99%, only up to the third month after application for electronic ear tag and intraperitoneal transponder; however, generalisation of results is subject to limitations due to a relatively small sample size. The application of the ear tag is a rather simple operation and can be done by the farmer without risks for the animal. In literature, Stärk et al. (1998) and, recently, Prola et al. (2010) reported a readability of 100% for electronic ear tags in pigs; in contrast, Babot et al. (2006) obtained a similar readability (96.7%) to the one observed in our trial. The reading shows a percentage of error of 0.1%, however, problems may arise as ear tags are subject to a high loss rate, up to 40% (Caja et al., 2004). Different performances could be explained by technical characteristics of ear tags (weight, shape, materials, etc.) that influ-

| Device   | Transponder size, mm | Readability, % | Recorded time, s |
|----------|----------------------|----------------|-----------------|
| EET      | 100                  | 96.7           | 100             |
| TIP      | 11.5                 | 94.5           | 84.3            |
| TAB      | 12                   | 93.8           | 11.0            |

Table 2. On-farm readability of the identification devices at fixed reading times.

| Reading times | Number of readable devices | EET | Readability, % | TIP | TAB |
|---------------|----------------------------|-----|----------------|-----|-----|
| Before the application | 96             | 100 | 100 | 100 |
| After the application | 72             | 100 | 58.3 | 100 |
| After 1 day | 86             | 100 | 91.6 | 100 |
| After 1 week | 93             | 100 | 100 | 100 |
| After 1 month | 90             | 100 | 100 | 100 |
| After 2 months | 83             | 100 | 80.9 | 100 |
| After 3 months | 83             | 100 | 80.9 | 100 |
| After 5 months | 64             | 93.8 | 100 | 86.7 |
| After 9 months | 64             | 93.8 | 100 | 86.7 |

Table 3. Comparison of readability of different devices in literature in pigs.

**References**

EET, electronic ear tags; T, ear tattoo; TIP, transponders injected in intraperitoneal position; TAB, transponders injected in the auricle base.
ence loss and breakage rates. Using electronic devices injected in the intraperitoneal position, many authors observed a comparable performance to the results obtained in the present trial. In fact, Klindworth et al. (2004) and Babot et al. (2006) observed a readability (94.5% and 98.1%). On the contrary, Caja et al. (2005) reported a good readability (99.6%) as Stärk et al. (1998), who obtained 100% with small size transponders, and Prola et al. (2010), with 32 mm-trasponders. We observed a better readability for transponders injected at the auricle base than Caja et al. (2005) (61%) and Klindworth et al. (2004) (72.2%). Even with larger transponders (>23 mm), other authors (Lambooj and Merks, 1989; Stärk et al., 1998) obtained a lower readability, while Prola et al. (2010) reported the same percentage, as summarized in Table 3.

One of the most important parameters for evaluating the suitability of an identification system for field use is the time needed for its application. The time required for the application differed significantly (P<0.001) among the four identification devices, each device being significantly different from the others (P<0.01). The method requiring the longest time was the tattoo with 20±6 s, followed by the transponder injected in the auricle base (14±4 s) and the transponder in the intraperitoneal position (11±4 s). For the application of the ear tag, the average time required was 7±3 s. The results reported in this experiment are in discordance with those reported by other authors (Table 3), who recorded longer times for the injection of electronic devices, ranging from 56 s (Babot et al., 2006) to 101.7 s (Caja et al., 2005). This huge variability among studies is probably due to the different equipment used, the level of experience of the operator and the method for restraining animals. Another important factor that might explain the differences found is how the time was recorded: we registered the time from immobilization to the end of application without including the capture of the animal and the preparation of the instruments as other authors probably did. Therefore, thorough information about experimental situation and how measures are taken should help to interpret the variety of results obtained by different authors. Very few problems have been reported regarding the injection of the transponder in the auricle base and intraperitoneally. Nonetheless, some authors underline the possibility of an inflammatory reaction after the injection and a chronic reparative process, without alteration of the long-term production parameters or animal health (Lambooj, 1992; Lambers et al., 1995; Prola et al., 2010). In our trial, no healing problems (infection or necrosis) were observed.

**Table 4. Mean duration (s) of states (±SD) over a 5 min period after the application of the four identification devices.**

| Behaviour          | Identification devices | EET | T | TIP | TAB |
|--------------------|------------------------|-----|---|----|-----|
| Lying              | Lateral                | 16±12 | 5±3 | 0  | 13±9 |
|                    | Ventral                | 47±31 | 42±20 | 44±41 | 39±15 |
|                    | Extended forelegs      | 5±4  | 0  | 11±11 | 20±17 |
|                    | Huddling               | 32±25 | 32±20 | 17±12 | 26±15 |
|                    | Isolated               | 5±5  | 11±11 | 6±4  | 13±10 |
|                    | Near other piglets     | 52±15 | 58±11 | 67±16 | 46±23 |
|                    | Near the sow           | 21±10 | 26±15 | 11±10 | 33±10 |
| Sleeping           |                        | 0    | 11±11 | 11±10 | 20±18 |
| Sitting            |                        | 11±9 | 11±8 | 11±11 | 13±10 |
| Standing           | Stiffness              | 42±40 | 32±31 | 44±33 | 39±35 |
|                    | Arched back            | 37±35 | 32±27 | 17±15 | 13±11 |
|                    | Wide apart legs        | 11±11 | 16±9  | 28±15 | 26±15 |
|                    | Leaning against structures | 5±3 | 16±16 | 22±15 | 0  |
|                    | Isolated               | 16±11 | 11±10 | 11±8  | 0  |

EET, electronic ear tags; T, ear tattoo; TIP, transponders injected in intraperitoneal position; TAB, transponders injected in the auricle base.

**Table 5. Frequency of occurrence of events in piglets for 5 min after the application of the four identification devices.**

| Behaviour          | Identification devices | EET | T | TIP | TAB |
|--------------------|------------------------|-----|---|----|-----|
| Lying              | Trembling              | 4   | 2 | 2  | 2   |
|                    | Scratching on littermates | 8±4 | 0±2 | 0±2 | 0±2 |
| Standing           | Trembling              | 4   | 5 | 7  | 3   |
|                    | Scratching belly       | 0   | 1 | 5  | 0   |
| Gait               | Insecure               | 6   | 8 | 5  | 7   |
|                    | Not uniform            | 5   | 4 | 4  | 4   |
|                    | Laternal               | 3±5 | 0±4 | 0±4 | 0±4 |
|                    | In circle              | 2   | 3 | 3  | 5   |
| Eating             |                        | 3   | 1 | 2  | 1   |
| Udder stimulation and sucking |            | 4   | 6 | 4  | 4   |
| Vocalization       |                        | 3   | 4 | 5  | 4   |
| Head position      | Shaking                | 47±4 | 11±4 | 5±4 | 9±4 |
| Ear position       | Relaxed                | 1   | 2 | 3  | 0   |
|                    | Tense                  | 7   | 3 | 8  | 6   |
|                    | Scratching             | 46±4 | 2±4 | 0±4 | 8±4 |

EET, electronic ear tags; T, ear tattoo; TIP, transponders injected in intraperitoneal position; TAB, transponders injected in the auricle base. *P<0.05.

Behaviour reactions

Piglets reacted to the application of the devices showing different behaviours as reported in Tables 4 and 5. The behaviour most frequently recorded was head shaking, which was observed significantly more after the application of ear tags (P<0.001; Table 5), probably because the piglets, during the application, were restrained by head immobilization (Battaille et al., 2002). Irritation caused by the application and the weight of the tag may also have induced the performance of this behaviour in an attempt to remove a source of annoyance (Vyklicky, 1984). This explanation is supported by the results of another behaviour, ear scratching, observed more frequently in piglets after the application of ear tags (P<0.001). Literature reports that head shaking and ear scratching are the behaviours observed most frequently after identification by ear incision (Noonan, 1994; Leslie et al., 2010). Only piglets identified with electronic ear tags were observed (Table 5) scratching on their littermates while lying down (P<0.01) and walking lateral (P<0.01). Lying near other
piglets was observed for relatively long times after all treatments: pigs are a highly social species and in nature they benefit from being members of a group (Stolba and Wood-Gush, 1989; Tosi et al., 2003; Scipioni et al., 2009). When feeling uncomfortable, piglets tend to gather with others searching for protection from their littermates and they react to being separated with acute screams and re-joining attempts.

Some authors (Hay et al., 2003; Llamas Moya et al., 2008), however, found that, after castration, piglets tended to remain isolated from the litter. Discomfort caused by castration is more intense and prolonged in comparison with the application of any identification device and it is likely that the level of prostration caused by pain is more relevant (Hay et al., 2003). Duration of behavioural states did not statistically differ between treatments: the great variability among individuals and recording times could partly explain this result. Moreover, compared to castration, the moderate discomfort caused by the application of identification devices may not have induced enough pain in order to observe larger behavioural differences among different treatments. Moderate pain due to handling procedures might compromise the welfare of animals in production systems; however to date the issue of mild animal pain has not been investigated thoroughly by the scientific literature.

The investment in electronic identification is generally greater than conventional ones, although price reduction due to the future spread of devices and equipment would make the EID less expensive.

In the present study it is likely that the application of intraperitoneal transponders caused only mild pain that led piglets to lean near littermates. Behavioural indicators considered in this study are meaningful in interpreting discomfort in piglets. However, to gain a clearer view of the degree of discomfort experienced, further studies should investigate behavioural reactions in association with suitable physiological parameters such as heart rate variability, thermography or pathological changes. This would provide useful information as moderate pain could impact on resilience to environmental stressors and animal welfare.

Conclusions

Results from this study show that tattoos were not readable after 9 months, while the readability was 86.7% for transponders injected in the auricle base, 93.8% for both transponders injected intraperitoneally and electronic ear tags. The last two devices are more suitable for identifying piglets than the system recognised by Italian law (tattoos) considering technical performance: losses, breakages, readability and time required for their application. The disadvantages of the ear tags are related to the negative short-term effect on the behaviour mainly due to head restraint, while the intraperitoneal injection is more difficult and requires a well-trained operator. Both identification systems are not directly related to consumable meat assuring food safety and reducing the risk in the food chain. On the contrary, the transponder injected into the auricle base does not seem an effective and valid electronic identification system compared to tattoos that reports the worst result in terms of readability and time of application.

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