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State-of-the-art of electronic identification techniques and applications in goats☆

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ABSTRACT

Use of electronic identification (e-ID) of caprine breeding stock, based on radio frequency passive transponders, is compulsory in most EU countries and it is foreseen as a powerful tool for the improvement of the goat industry. This paper compares the performances of the most used e-ID devices (i.e., ear tags, injects, boluses and leg tags) with plastic ear tags in goats. Ear dimensions, environment and ear tag features result in variable retention and readability of visual and e-ID ear tags in goats. Light and high quality button ear tags provide suitable results under intensive conditions but they are not fully satisfactory under extensive conditions. Injectable transponders have been also evaluated in different body sites (ear base, armpit, groin, tail, pastern and intraperitoneal) of goats. Main drawbacks of injects are migration and retrieval at slaughter, but injection in the armpit is suitable for goats under harsh conditions (i.e., game and feral goats) and carcass traceability. Injection in the pastern has the advantage of not letting carcass residues, although readability is compromised by the small size of the transponders used and is not recommended for most on-farm applications. Performances of e-ID rumen boluses vary by bolus features and goat breed. Research showed that denser boluses than in sheep (>3.3) and high quality transponders allow >98% readability in goats. Leg tags are only recommended for adult dairy goats under intensive conditions. Dynamic reading efficiency strongly depends on the position of the antenna and on the type of e-ID device, which becomes an issue of major relevance when different e-ID device types are in use in the same herd for management and performance recording.

1. Introduction

Electronic identification of goats has become an issue of interest since the publication of the European Union (EU) regulations on the identification (ID) and registration of sheep and goats born in 2010 or later. The EU regulations (EC 21/2004; EC 933/2008; EC 759/2009) lay down the compulsory use of 2 ID devices (visual, v-ID;

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electronic, e-ID) for sheep and goats intended for replacement (>6 mo of age), or before leaving the farm of origin, in all EU member states having more than 600,000 sheep and goats, or where the total number of goats is greater than 160,000 head. Animals intended for slaughter before 12 mo of age may be tagged with only a visual ear tag, referred as temporary tag. The e-ID, also known as radio frequency ID (RFID), is based on the use of passive (without battery) transponders (transmitter-responders) which are activated by the signal emitted by a reader or transceiver (transmitter-receiver) and they respond emitting an exclusive ID code. The energy required for RFID devices comes from a generated electromagnetic field from the reader, and no internal energy source restricts the lifespan of transponders (Artmann, 1999). Official animal e-ID uses low radio frequency (134.2 kHz) and the code structure and air interface are regulated by the International Organization for Standardization (ISO, 1996a,b, 2006). Two air interface (radio-based interchange of information link) technologies are recognized by the ISO standards, corresponding to half-duplex (HDX) and full-duplex (FDX-B). Although controversial, recent comparative experimental data show greater readability of HDX devices under on-farm conditions (Ait-Saidi et al., 2013).

Ear tags, rumen boluses, and identification devices in the pastern (i.e., injects and leg bands) are the devices approved for official use in the EU, each member state being entitled to choose the preferred ID device to be used in practice. Detailed information on electronic devices for animal identification and their manufactures can be obtained from the International Committee for Animal Recording website (ICAR, 2014). In the case of goats, the possibility of using such variety of ID devices is caused, to a high extent, by the variable readability obtained in different experiments (Capote et al., 2005; Carné et al., 2009a; JRC, 2003; Pinna et al., 2006; Schuiling et al., 2004). In the USA, v-ID has been broadly used within the goat health surveillance programs, although e-ID was recommended for the deployment of the National Animal Identification System and is currently authorized (USDA, 2013).

To our knowledge, the only review on goat e-ID was published more than 15 yr ago (Caja et al., 1997), which justifies an updated re-evaluation of the topic. As v-ID, based on plastic ear tags, is still the method of reference for all livestock species, allusion to available research on v-ID feasibility in goats is also made.

2. Visual ear tags (v-ET)

Goat ear features, as standing pattern (erect, horizontal or pendulous), thickness (thin or thick) and length (gopher, elf, wild type or long), vary widely according to breed (i.e., Lamancha, <2.5 cm; Nubian >20 cm) and individuals, compromising v-ET retention. Ear size in goats depends on an autosomal gene partially dominant being the gopher or rudimentary type (<2.5 cm) the dominant allele (COGNOSAG, 1986). Moreover, goat behavior (i.e., biting) and grazing conditions (i.e., net fences, bushy areas, rangelands) also have a negative impact on v-ET retention in practice. As a consequence, v-ET performances vary dramatically within and between goat breeds and herds. Additionally, incorrect application (out of the middle of the ear pinna), ear tag design (shape and dimensions, weight, pin length) and manufacturing material (elasticity, endurance, biocompatibility, etc.) also modify the performances of v-ET in goats.

Published data on performances of plastic v-ET in goats is relatively scarce, as summarized in Table 1. Most available references came from data reported in disease eradication programs of dairy goats managed under intensive conditions and show wide ranges of variation in losses (0–20.0%) and breakages (0–24.9%), producing a variable readability which averaged 87.4 ± 2.0%.

Readability of ID devices is usually expressed as:

$$R\ (\%) = \left(\frac{\text{readable devices}}{\text{applied devices}}\right) \times 100$$

In the case of v-ET it coincides with the device's overall identification efficiency and it is mainly dependent on their losses, which are basically due to ear breakage or healing problems (i.e., infection, biological compatibility) producing ear splitting; however, ear tag damage (e.g., biting) and breakage (e.g., flag loss) have also been described in goats, which can seriously compromise the readability of the printed codes in the v-ET. Button devices are usually less subjected to losses and breakages than flag tags in goats (Carné et al., 2009a), although the effects of v-ET features on their long-term performances remains to be thoroughly studied. Moreover, as indicated by Edwards et al. (2001), there are welfare concerns related to v-ET in small ruminants.

In conclusion, v-ET made of plastic show variable readability rates, remaining in most cases under the 98% recommended by the International Committee for Animal Recording for official ID (ICAR, 2012) and are not fully satisfactory in practice, as recognized by most goat keepers. If the need of tamper-proof devices is also considered, the exclusive use of v-ET cannot be recommended for the deployment of official ID programs and alternative or double ID systems are required in practice.

3. Electronic ear tags (e-ET)

The e-ET usually consists of plastic buttons, used as the female piece of ear tags, with round antennas and electronic components imbibed in polyurethane casts. Given that more plastics are porous, a main concern on e-ET is the water resistance of their electronic components. This aspect should be taken into account in e-ET endurance tests. For this reason, new devices based on glass encapsulated transponders (i.e., strip set tags) are preferred nowadays.

Similarly to v-ET, evaluating the healing process of tagging wounds is of relevance in e-ET. Using design-improved e-ET devices in adult and goat kids, Schuiling et al. (2004) indicated that nearly 30% of tagging wounds were unhealed after 2 mo in both kids and does. At 4 mo, 5% of kid ears remained unhealed, as well as 8.5% of doe ears. At the end of the study (8 mo), ears not fully healed were 1.7 and 2.7% for kids and does, respectively, although healing varied between herds. Biocompatibility problems were reported by Carné et al. (2009a) who observed 6.5% of tissue reaction,