Rev. sci. tech. Off. int. Epiz., 2014, **33** (3), ... - ...

Use of electronic leg tags for identification of small ruminants

This paper (No. 17092014-00041-EN) has been peer-reviewed, accepted, edited, and corrected by authors. It has not yet been formatted for printing. It will be published in December 2014 in issue 33-3 of the *Scientific and Technical Review*

J.A. Abecia* & I. Palacín

Departamento de Producción Animal y Ciencia de los Alimentos, Universidad de Zaragoza, Miguel Servet 177, 50013 Zaragoza, Spain

*Corresponding author: alf@unizar.es

Summary

Few studies have evaluated the use of electronic leg tags for identification of small ruminants; thus the objectives of this study were *i)* to quantify the degree of development in the body region where the tags are placed, *ii)* to assess the effect of the farm management system on the suitability of the leg tags, and *iii)* to assess tag readability under dynamic conditions, i.e. as animals moved through a raceway. In three experiments, leg tags were applied as follows: 24 ewe lambs and 24 kid goats (Experiment 1); 37 kid goats (Experiment 2); 1,519 goats and 248 sheep (Experiment 3). At 2.5 months of age, metatarsal perimeter of ewe lambs and kid goats was 80% of the adult values; at 6 months of age, metatarsal perimeter had reached 90% of the adult values but live weight had not exceeded 65% (Experiments 1 and 2). In Experiment 3, the retention rates of tags on farms where animals were housed indoors were between 99.2% and 100% after one year. On the farm where animals grazed natural pasture the retention and readability rates six months after tagging were 63% and 78.2%. Dynamic readings indicated 100% efficiency. In conclusion, the selection of the leg of replacement animals for attachment of these tags is appropriate because their normal development is not impeded. For different breeds, it might be necessary to identify the optimal age for tagging. Extensive rangeland grazing systems can reduce the retention of leg tags. The electronic tag evaluated in this study showed a high readability rate under dynamic conditions.

Keywords

Electronic identification – Goat – Leg tag – Readability – Retention – Sheep.

Introduction

Regulation 21/2004 of the Council of the European Union (EU) established a system for the identification and registration of ovine and caprine animals in which all animals in a holding born after 9 July 2005 in Member States that have >600,000 animals or >160,000 goats have to be identified by an ear tag and a passive electronic transponder, which may be inserted into an electronic ear tag or into a ruminal bolus (1). At the end of 2008, the Council revised the list of electronic devices available on the market in Commission Regulation 933/2008, such that the competent authority will approve the means of electronic identification as either a ruminal bolus or an electronic ear tag and, for animals not involved in intra-community trade, an electronic identifier as either a marker on the pastern (electronic leg tag) or an injectable transponder on the metatarsus (2). Few studies have evaluated the use of electronic leg tags in small ruminants: one such device has been evaluated in goats in Spain (3) and achieved satisfactory visual and electronic readings, and the efficacy of two electronic devices for official identification of goats has been tested in France (4).

The European Council now requires that replacement sheep and goats have to be assigned electronic identification before 6 months of age, therefore, one objective of this study was to quantify the degree of development of the body region where the leg tags are placed (Experiments 1 and 2), because these devices are in place permanently and might prevent normal growth of the pastern by causing leg constriction. In addition, as with other external devices such as ear tags, leg tags are exposed to the environment (facilities, fences, bushes), therefore a further objective was to assess the effect of the farm management system (natural pasture versus permanent housing; Experiment 3) on the suitability of the leg tags. In Experiments 1 and 3, the readability of the leg tags was evaluated under dynamic conditions as the animals moved through a raceway.

Materials and methods

All procedures were performed under Project Licence PI06/09, which was approved by the in-house Ethics Committee for Animal Experiments at the University of Zaragoza, Spain. The care and use of animals followed the Spanish Policy for Animal Protection RD1201/05, which meets EU Directive 86/609 on the protection of animals used for experimental and other scientific purposes (5).

The electronic leg tag (Patuflex, ITW Reyflex, Thyez, France) used in the experiments was a yellow polyurethane bracelet measuring 160 × 30 × 2 mm (14 g) (Fig. 1); this was placed on the right hind limb, around the metatarsus, covering the entire region (Fig. 2). The bracelet was equipped with an electronic circular transponder that met ISO 11784 and 11785 (FDX-B, 134.2 kHz) standards on electronic animal identification (International Committee for Animal Recording [ICAR]-approved device) (6). To optimise the fit of this bracelet, there is a choice of three positions that provide three inner diameters (10.6, 11.7 or 12.7 cm). To ensure that a chosen diameter is retained, two plastic fasteners that secure the device are inserted into the head of the bracelet, which is then broken off. An operator selected the proper position and engagement of each bracelet. In addition, to ensure individual identification in the event that a leg tag was lost, one visual ear tag was affixed to each animal. Two full ISO handheld transceivers (Universal Reader, Felixcan, Spain; AWR100 Stick Reader, Agrident, Germany) were used to confirm the readability of the leg tags. Dynamic readings were recorded using an ISO static reader (Centurión, Felixcan, Spain) that was positioned on a runway (width 45 cm) and connected to a vertical antenna (85 × 68 cm) fixed to the right side of the runway.

Experiment 1

The first experiment took place in 2011–2012 at the experimental farm of the University of Zaragoza, Spain, using 24 Rasa Aragonesa ewe lambs and 24 Murciano-Granadina kid goats (mean ± SE birthdate: 7 November 2010 ± 1 d and 24 November 2010 ± 1 d, respectively). When the animals were 2.5 months old, they were assigned to monospecific groups and fed a diet based on their growth requirements. Thereafter, and until they were 7.5 months old, live weight (LW, kg) was recorded every two weeks, as was the metatarsal perimeter (MP) of the right hind leg, which was measured using a measuring tape (cm). At the same time, to calculate the degree (percentage) of development in MP and LW of the kids and lambs relative to adults, the MPs and LWs of 50 adult goats and 50 ewes at the farms from which the experimental animals originated were recorded.

At 5 months old, the animals were individually identified using the electronic leg tag; thereafter, the tags were read every two weeks using the handheld transceivers. At the same time, to assess the efficiency of the devices in replacement animals in dynamic conditions, readings were taken in the runway. Instances of alopecia at the tagging site, wounds, constriction or signs of pain were documented. The experiment ceased when the animals were 7.5 months old.

Experiment 2

The second experiment took place in 2010 on a dairy goat farm (Davayé, France) and used 20 Saanen and 17 Alpine kid goats (mean ± SE birthdates: 2 November 2009 ± 2 d and 6 September 2009 ± 2 d, respectively). Recording of MP and LW was similar to Experiment 1 but single measurements were taken at 6 months of age only.

Experiment 3

In the third experiment (2011), a total 1,519 goats and 248 sheep (2 to 8 years old) on three commercial farms were given an electronic leg tag for individual identification. Farm A (Nueno, Spain) used an extensive system and had 400 mixed-breed meat goats that grazed natural pasture daily and went up into mountain pastures for four months in summer (June through September). A total of 344 goats received electronic leg tags. Farm B (Davayé, France) was an intensive dairy farm where animals were kept indoors year-round and, at the time of experiment, 1,119 either Saanen or Alpina goats received electronic leg tags. Farm C (Ontiñena, Spain) was a meat sheep farm that followed an intensive system with permanent indoor housing. At the time of experiment, 248 of the 1,200 ewes received electronic leg tags.

In evaluating the efficacy of the electronic leg tag to identify individual small ruminants, the experiments followed the protocols approved by ICAR. On Farms A and C, leg tags were read before tagging (R00), at tagging (R0), and 7 ± 3 d (R7), 30 ± 7 d (R30), 90 ± 15 d (R90), 180 ± 15 d (R180), 270 ± 15 d (R270) and 360 ± 15 d (R360) after tagging. On Farm B, leg tags were read at R00, R0 and R360. The time (s) required to tag individual animals was recorded on Farms A and C. On Farm C, dynamic readings were taken at R90, R180 and R360.

The retention rate (%) of the leg tags was calculated as:

(number of retained tags / [number of tagged tags - number of sold or dead tagged animals]) × 100

The readability rate (%) was calculated as:

(number of read tags / number of readable tags) × 100

The efficiency of the dynamic readings (efficiency rate [%]) was calculated as:

(number of read tags / number of readable tags) × 100, after five consecutive passes through the runway.

The time taken to read each unit (‘unitary reading time’: s/animal) (1) was calculated as:

total time passing through the runway / number of animals.

In Experiment 1, some animals presented tags displaced below the sesamoid bone, therefore analysis of variance was used to compare the MP in animals with or without the tags displaced. A chi-squared test was used to compare readability rates between farms.

Results

Experiment 1

Changes in the LW and MP of ewe lambs and kid goats as percentages of those of adults throughout the experiment are shown in Figure 3. The mean LW and MP of adult Rasa Aragonesa ewes were 60 kg ± 5 kg and 9.50 cm ± 1.10 cm and of Murciano-Granadina goats 60 kg ± 3 kg and 8.80 cm ± 0.60 cm, respectively.

Changes in LWs and MPs showed different patterns in the two species. At 2.5 months of age, the mean LWs of the lambs (19.2 kg ± 3.0 kg) and kids (12.9 kg ± 2.8 kg) were well below adult values (32% of mean adult ewe LW and 22% of mean adult goat LW); however, the mean MPs of lambs (7.5 cm ± 0.5 cm) and kids (7.1 cm ± 0.5 cm) were about 80% of the adult values (79% of mean adult ewe MP and 81% of the mean adult goat MP). At 6 months of age (the age at which the EU requires that animals be identifiable using electronic leg tags), the MPs of the lambs (9.0 cm ± 0.4 cm) and kids (7.9 cm ± 0.6 cm) had reached at least 90% of adults values (95% of mean adult ewe MP and 90% of mean adult goat MP); however, the LWs of the lambs (38 kg ± 4 kg) and kids (23 kg ± 4 kg) had not exceeded 65% of the mean LWs of adult ewes (63%) and goats (38%).

Within two weeks of being tagged, six animals that had a relatively small MP compared with the other animals ($p<0.01$) had tags displaced below the sesamoid bone. Those tags were repositioned to their original location. No instances of alopecia, injury or signs of pain occurred in the experiment. In both lambs and kids, dynamic readings indicated 100% efficiency in every pass through the runway; the mean unitary reading times were 1.88 s/lamb and 1.25 s/kid.

Experiment 2

On the dairy goat farm in France, the mean (± SE) LW and MP of adult Saanen goats were 76 kg ± 2 kg and 10.9 cm ± 1.1 cm and of adult Alpine goats 65 kg ± 1 kg and 9.86 cm ± 0.8 cm, respectively. At 6 months of age, the mean (± SE) LW of Saanen kids (32.5 kg ± 0.9 kg) was 43% of the mean adult LW and the mean MP (8.7 cm ± 0.1 cm) was 80% of the mean adult MP. At the same age, the mean LW of Alpine kids (28.2 kg ± 0.5 kg) was 43% of the mean adult LW and the mean MP (8.6 cm ± 0.1 cm) was 87% of the mean adult MP.

Experiment 3

On Farms A and C, a total of 200 adult sheep and 125 goats were tagged per hour (20 s/sheep and 32 s/goat). After one year, the retention rates of leg tags on the farms where the animals were always indoors were 100% (Farm B) and 99.2% (Farm C). The readability rate on Farm C (98%) was slightly lower than the retention rate, which indicated that some animals retained their leg tags but they could not be read (Table I).

On Farm A, where the animals were permanently outdoors, retention and readability rates at R90 decreased to 94.5% and 78.2%, and at R180 the rates were 63% and 78.2%, respectively. The latter readings were taken immediately after the flock had returned from the summer mountain pastures. Retention rates were well below the ICAR requirements for this type of electronic tag, therefore the remaining scheduled readings were cancelled. On Farm A, where about 20% of the leg tags that were retained could not be read, the retention rates and readability rates were notably lower than on the other farms ($p<0.01$). On Farm C, the dynamic readings indicated 100% efficiency during every pass through the raceway. Mean unitary reading time was 2 s/sheep.

Discussion

Under the experimental conditions and with the breeds used in this study, the electronic leg tag was suitable for use on replacement sheep and goats before 6 months of age because the metatarsus of the animals reached 90% of the adult value, no tags were lost and no signs of constriction were apparent. To be approved as an official means of identification, the main criteria are that the tag should be tamper-proof and harmless to the animal. Unlike ear tags and ruminal boluses, leg tags are secured permanently to the animal at the moment of application; therefore, the tag should allow the operator to leave some space between the leg and the tag so that it is not constraining but does not allow the tag to be lost. Some types of electronic leg tag allow an increase in leg diameter as the animal grows but can be difficult to affix to the animal and can be tampered with.

In Experiment 1, 25% of the tags slid downward within the first two weeks after they were applied. The MPs of the kids in this experiment were slightly bigger than reported elsewhere (3), although the MP of adults in Experiment 1 differed from those reported (3). The leg dimensions of each breed and even the dimensions of the animals on individual farms should be taken into consideration when choosing the optimum age to tag replacement animals. This is especially important when factors such as artificial rearing can compromise the normal growth of a breed.

The pioneering work of Hammond in 1932 (7) presented the ordering of tissue growth in sheep. If growth in animals is considered as weight gain from birth until adulthood and development as changes to proportions, conformation, body chemistry and physiological functions with advancing age, the bone tissue has earlier growth than other tissues (muscle and fat), which means that replacement animals present an MP close to that of an adult, thus facilitating tag insertion and avoiding early problems.

The ICAR instructions for field trials (8) indicate that a device should have an efficacy >99% after 6 months or 98% after 12 months. Under the assumption that readability rate is the most appropriate index for estimating the efficacy of these electronic leg tags, because they are retained by the animals but are not always readable, the electronic leg tag evaluated in the present study met the ICAR (8) requirement for use in intensive systems where animals are permanently indoors. Similar results were obtained when another type of leg tag was tested on Murciano-Granadina goats that were permanently housed (3). On Farm A, where the animals were permanently outdoors, 5.5% of the leg tags had been lost after only 90 days and, most importantly, almost 22% of the retained tags could not be read. Undoubtedly, the time that the goats spent in the mountains increased the likelihood of losses and tag failures because the flock returned to the farm with almost 40% of the tags lost.

Published accounts of the effect of a farm system on retention rates of external identification tags are limited. However, it has been reported that the type of fencing influenced ear tag losses and failures in pigs; tag losses were reduced after stone blocks replaced barbed-wire fences (9). Iberian pigs were significantly less likely to lose electronic ear tags when they were in enclosures that had a stone wall rather than a grid wall perimeter (10). A comprehensive report by the Canadian Cattle Identification Agency, where several visual ear tags were compared in differing Canadian environments (brush, grass, forest, native grass, rocky), concluded that environmental conditions and on-farm management (feeder design, fence design) should be considered when choosing tags that will meet minimum tamper-evidence, retention and readability rates (11).

In the present study, dynamic readings reached 100% efficiency in all cases, which is remarkable. In France, similar results have been found when using the same leg tag (4). A device should be approved by ICAR if its dynamic readability is >95%.

The time spent applying leg tags per individual animal in the present study was less than the time reported for applying ‘Animalcomfort’ leg tags (53 s) (3), but was similar to the times required to apply an electronic bolus in several breeds in the United States of America (22 s) (12) and in kids and adult goats (28 s) (13), or the time required to introduce injectable transponders in lambs and kids (30 s to 40 s) (13, 14).

Conclusions

Selection by the European Commission of the leg as the body region on which electronic tags should be applied in small ruminants is appropriate because, at the legal maximum age at which replacement animals must be tagged (6 months), the tag does not impede normal development of the leg. Animals can receive this tag when they reach 90% of the adult MP (40% of the adult LW); however, some breeds have shown relatively slow growth of this area of the leg. For each breed, therefore, it might be necessary to identify the optimal age at which individuals should receive the leg tag evaluated in this study.

The farming system is an important factor to consider when choosing an electronic tag. This study has shown that extensive rangeland grazing systems can reduce retention of leg tags. In addition, the difference between readability rate and retention rate indicates that some of the retained tags were damaged, possibly through encounters with rocks or other objects, and warrants investigation. The tag evaluated in this study showed a high readability rate under dynamic conditions, which makes it useful in automated farm processes such as electronic drafting systems, scales and milking parlours.

Acknowledgments

The authors thank farmers Javier Ferrer and Antonio Ordás for their contribution to the experiments, the Institut de l'Élevage (France) for the French experiments, 'La Pardina' farm for providing the kid goats, and Bruce MacWhirter for the English revision of the manuscript.

References

1. European Union (2004). – Council Regulation (EC) No. 21/2004 of 17 December 2003 establishing a system for the identification and registration of ovine and caprine animals and amending Regulation (EC) No. 1782/2003 and Directives 92/102/EEC and 64/432/EEC. *Off. J. Eur. Union*, **L** 5, 8–17.

2. European Union (2008). – Commission Regulation (EC) No. 933/2008 of 23 September 2008 amending the Annex to Council Regulation (EC) No. 21/2004 as regards the means of identification of animals and the content of the movement documents. *Off. J. Eur. Union*, **L** 265, 5–11. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R0933&rid=1 (accessed on 12 September 2014).

3. Carné S., Caja G., Rojas-Olivares M.A. & Salama A.A.K. (2010). – Readability of visual and electronic leg tags versus rumen boluses and electronic ear tags for the permanent identification of dairy goats *J. Dairy Sci.*, **93**, 5157–5166.

4. Balvay B. & Debroux A. (2011). – Automatisation en filière caprine : valorisations attendues de la bague au paturon électronique. *Innovations Agronomiques*, **17**, 277–290.

5. European Commission (EC) (2006). – Council Directive 86/609/EEC of 24 November 1986 on the approximation of laws, regulations and administrative provisions of the Member States regarding the protection of animals used for experimental and other scientific purposes. Available at: eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31986L0609:en:HTML (accessed on 24 April 2014).

6. International Committee for Animal Recording (ICAR) (2014). – ICAR approved RFID devices and corresponding Manufacturers' Codes. Available at: www.service-icar.com/manufacturer_complete.php/ (accessed on 24 April 2014).

7. Hammond J. (1932). – Growth and the development of mutton qualities in the sheep. A survey of the problems involved in meat production. Oliver and Boyd, Edinburgh and London.

8. International Committee for Animal Recording (ICAR) (2012). – International Agreement of Recording Practices. Guidelines approved by the General Assembly held in Cork, Ireland, June 2012. Available at:

www.icar.org/Documents/Rules%20and%20regulations/Guidelines/Guidelines_2012.pdf/ (accessed on 24 April 2014).

9. Gosálvez L.F., Santamarina C., Averós X., Hernández-Jover M., Caja G. & Babot D. (2007). – Traceability of extensively produced Iberian pigs using visual and electronic identification devices from farm to slaughter. *J. Anim. Sci.*, **85**, 2746–2752.

10. Jaume J., Tibau J. & González J. (2012). – Permanence of electronic ear tags in extensive rearing of Majorcan black pig. New trends for innovation in the Mediterranean animal production. *EAAP Scientific Series*, **129**, 237–239.

11. Stanford K., Stitt J., Kellar J.A. & McAllister T.A. (2001). – Traceability in cattle and small ruminants in Canada. *In* Traceability of animals and animal products (H.A. MacDaniel & M.K. Sheridan, eds). *Rev. sci. tech. Off. int. Epiz.*, **20** (2), 510–522.

12. Carné S., Gipson T.A., Rovai M., Merkel R.C. & Caja G. (2009). – Extended field test on the use of visual ear tags and electronic boluses for the identification of different goat breeds in the United States. *J. Anim. Sci.*, **87**, 2419–2427.

13. Carné S., Caja G., Ghirardi J.J. & Salama A.A.K. (2009). – Long-term performance of visual and electronic identification devices in dairy goats. *J. Dairy Sci.*, **92**, 1500–1511.

14. Abecia J.A., Valares J.A., Forcada F., Palacín I. & García L. (2004). – Utilización de unidades electrónicas subcutáneas para la identificación del ganado ovino. *Pequeños Rumiantes*, **5**, 10–14.

Table I
Experiment 3: retention and readability rates recorded on Farm A (goats, outdoors) and Farm C (sheep, indoors)

Farm A Reading[(a)]	Tagged[(b)]	Retained	Retention	Read	Readability
R0	344	344	100%	344	100%
R7	341	341	100%	341	100%
R30	340	339	99.7%	339	100%
R90	325	307	94.5%	245	78.2%
R180	325	205	63%	160	78.2%
R270	Cancelled				
R360	Cancelled				
Farm C Reading[(a)]	**Tagged[(b)]**	**Retained**	**Retention**	**Read**	**Readability**
R0	248	248	100%	248	100%
R7	248	248	100%	248	100%
R30	248	247	100%	247	100%
R90	247	245	100%	245	100%
R180	245	227	100%	227	100%
R270	211	211	100%	211	100%
R360	211	210	99.5%	207	98.6%

Retention = no. retained tags / (no. tagged tags - no. sold or dead tagged animals)

Readability = no. read tags / no. readable tags

a) Days after tagging

b) Differences on subsequent reading dates due to dead or sold animals

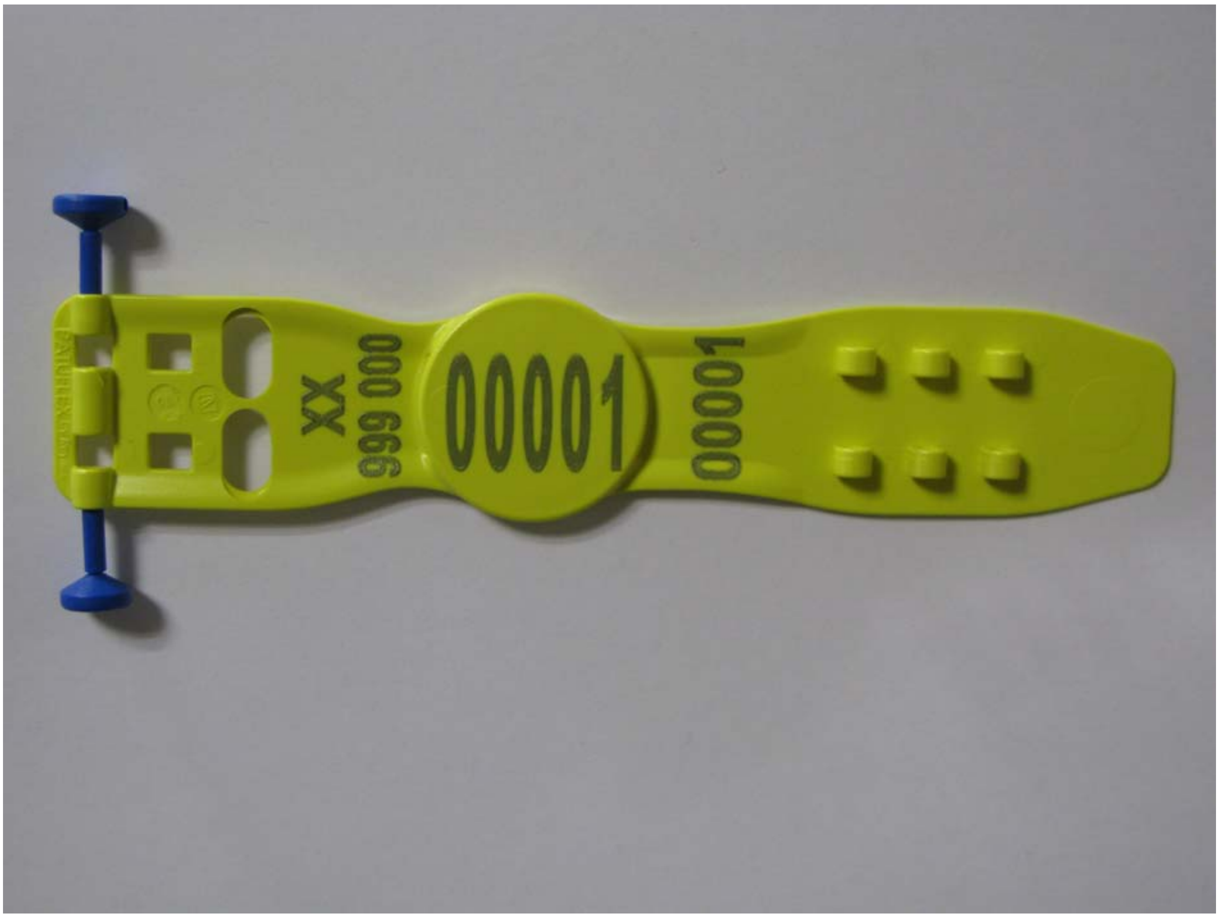
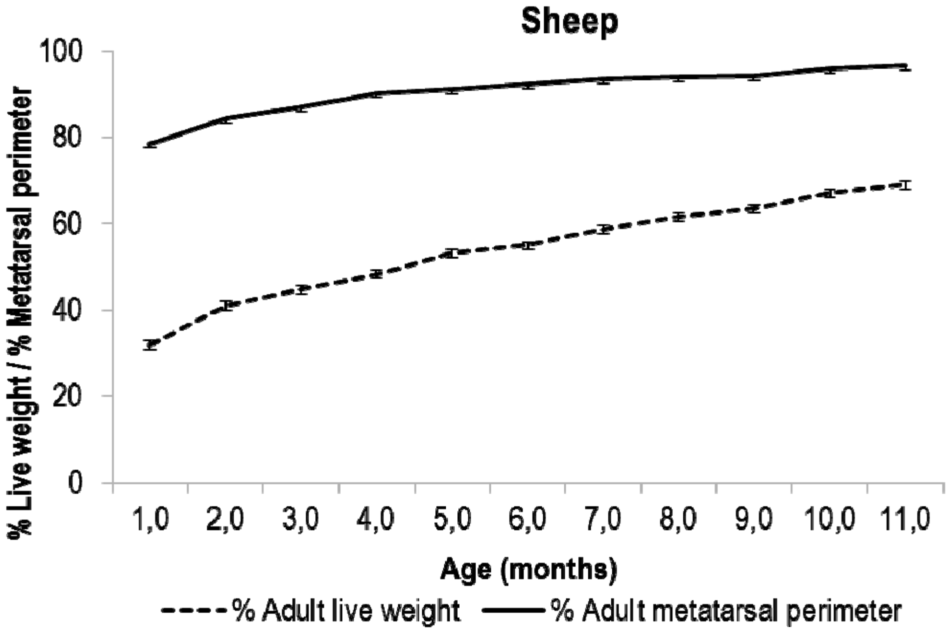


Fig. 1
Electronic leg tag used in the experiments

Fig. 2
Electronic leg tag placed around the metatarsus on the right hind limb of a goat



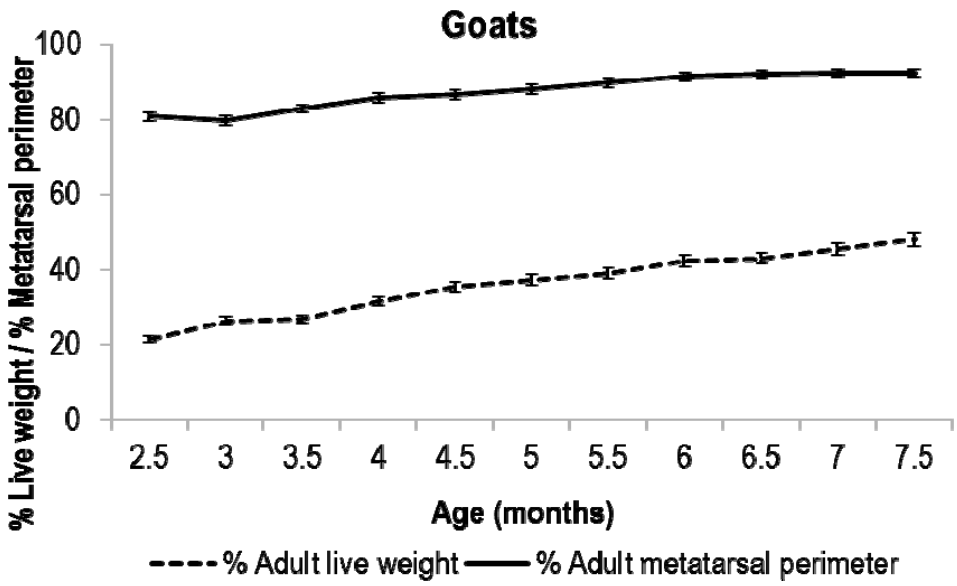


Fig. 3

Changes in the live weight and metatarsal perimeter (mean ± SE) of Rasa Aragonesa ewe lambs and Murciano-Granadina kid goats between 2.5 and 7.5 months of age as a percentage of adult values