Retinal image recognition for identifying and tracing live and harvested lambs

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INTRODUCTION

Traceability is key for the current Agrifood Global Market. Regarding animals, **tracking from birth to slaughter** is needed, which is a complex process, difficult and partially solved at nowadays.

Identification (**ID**) by means of retinal image recognition (**RIR**) is based on the **uniqueness** of retinal vascular pattern and may be a tool of interest for auditing traceability.

The aim of this study was to evaluate the use of RIR technology for sheep ID and traceability.

MATERIALS & METHODS

- **Animals & Management:**

152 lambs from 2 breeds (Lacaune, n = 70; Manchega, n = 82), individually ID according to EU standards at birth (2.8 g ear tag; Azasa, Madrid, Spain) and at weaning (1 mo) in duplicate (5.2 g ear tag and 19 g electronic mini-bolus; Azasa), were used.

- **Retinal Imaging Recognition:**

Images and time (**CT**) were recorded in duplicate by using an **OptiReader** device (Optibrand, Fort Collins, Colorado, USA) at: 3 mo-live (n = 152) and -harvested (cut head; n = 50)
   6 mo-live (n = 58)
   12 mo-live (n = 58)

RIR (**1,272 images**) were treated by the Optibrand Data Management Software and the 3-mo RIR were used as the reference for analysis. First 2 wk were used for operator training (264 images). Matching score (**MS**) was used as exclusion criterion (MS < 80).

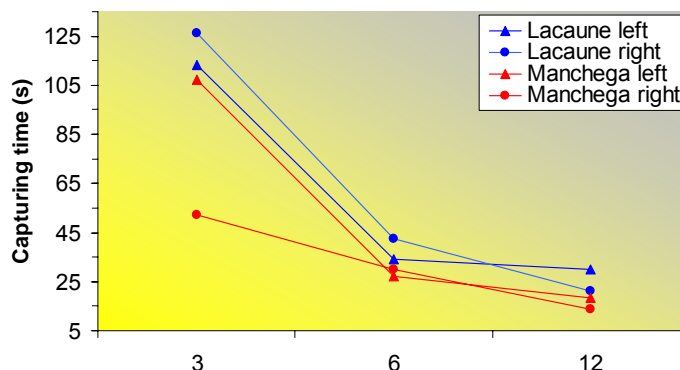Data analysis was done by using PROC CATMOD and MIXED of SAS (v. 9.2).
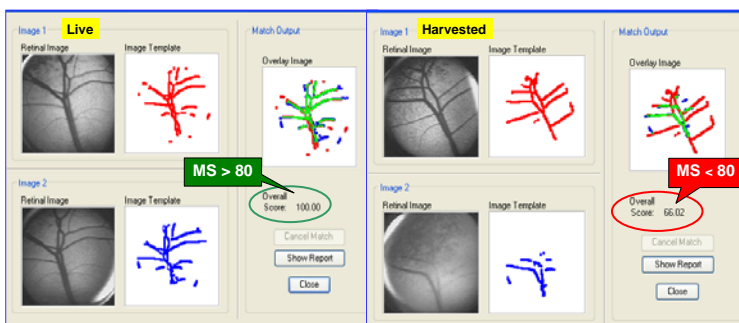
RESULTS & DISCUSSION

Capturing time decreased quadratically (R^2 = 0.95) with operator training ($P < 0.001$).

Values of MS and CT improved from training (92 and 144 s) to mo 12 of age (96 and 21 s).

Capturing time (s) of retinal images of sheep according to age and breed

Matching scores (mean ± SE) of retinal images of sheep according to breed, age and condition

Comparison	Age (mo)	Condition	Breed (n) Manchega	Breed (n) Lacaune	Overall (n)
Intra-age (repetitions)	3	Training	92.5 ± 1.8 (33)	91.7 ± 1.4 (33)	92.1 ± 0.8 (66)
		Live	97.5 ± 0.5 (49)	94.8 ± 1.0 (37)	96.4 ± 0.5 (86)
		Harvested	70.5 ± 3.0[a] (29)	63.1 ± 2.2[b] (21)	67.4 ± 2.0 (50)
	6	Live	96.2 ± 0.8 (28)	96.2 ± 0.9 (30)	96.2 ± 0.6 (58)
	12	Live	96.4 ± 1.0 (28)	96.3 ± 0.8 (30)	96.3 ± 0.6 (58)
Inter-age	3 vs. 6	Live	91.8 ± 1.9 (28)	90.1 ± 1.6 (30)	90.9 ± 1.2 (58)
	3 vs. 12	Live	91.7 ± 1.6 (28)	89.6 ± 1.5 (30)	90.6 ± 1.1 (58)
	3	Live vs. Harvested	60.2 ± 2.5 (29)	55.9 ± 2.3 (21)	58.4 ± 1.8 (50)

[a, b] $P < 0.05$

Intra-age breed effects were detected in CT ($P < 0.001$). MS in the harvested lambs was low and RIR comparisons unsatisfactory. Inter-age image analysis, used as a traceability indicator, showed a MS of 90 on average without breed effects.

Percentage on average of RIR launched an inter-age MS >80 of 83.6%.

CONCLUSIONS

- **Capturing time:** trained operator processed sheep in **20-30 s,** allowing a **throughput > 100 sheep/h**

- **Averaged precision for matching lambs** was:
  Live   (3-12 mo)   **81-86%**
  Harvested (3 mo)   6%

- **Retinal image recognition** was a useful technology for auditing the identity of **living lambs**, but its use was not adequate in harvesting plants.