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Vocalizations emitted by goats: are there any differences between bleats depending on the contexts of emission?

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The project VOCAPRA aims to implement an early-warning IT tool for improving animal welfare by continuously and non-invasively monitoring vocalizations in goat herds. On the basis of specific acoustic features of vocalizations emitted by the animals, the tool will send notifications to the farmer about goats' emotional state triggered by specific emission contexts. Acoustic sensors and cameras were installed in four goat farms (305 goats overall) for continuous recording of spontaneous vocalizations and behaviour. Each vocalization was associated to a specific context of emission (feeding distribution, daily routine, extraordinary farm maintenance/cleaning, intraspecific bleating, mother-kid separation, goats' handling, exit to pasture, calling the farmer, presence of unknown persons). The acoustic features (pitch, P (logarithmic scale); envelope, E (decibel); spectral centroid, C (logarithmic scale); roughness, R (exponent values); duration, T (seconds)) of more than 2000 vocalizations were extracted. For each feature, except for T, the mean value (m), the variability (i), the average trend (d_m) and the variability of the trend (d_i) were calculated. A principal component (PC) analysis on these variable revealed that 12 over 16 PCs explain 95% of total variance and that some variables (P_i, Cd_m, R_i, Rd_m and Rd_i) carry almost no information on the first two PCs. For these preliminary analysis, differences among contexts on the remaining features were compared by ANOVA merging vocalisations from the four farms. Post-hoc pairwise comparisons were carried out for features that resulted significantly different. The variables that presented the highest variation among contexts were P_m, C_m and R_m. Differences were found between feed distribution and daily routine operations (R_m=4.20±1.70 vs 3.20±2.17; P_m=60.87±9.43 vs 64.44±7.86; C_m=92.97±2.65 vs 95.81±3.01, respectively; $p<0.05$). Bleats emitted during mother-kid separation had higher R_m and lower P_m and C_m than those emitted during daily routine operations (R_m=4.22±1.42 vs 3.20±2.17; P_m=59.58±7.99 vs 64.44±7.86; C_m=93.37 ± 1.77 vs 95.81±3.01, respectively; $p<0.05$). Intraspecific bleating presented significantly higher P_m and lower C_m and R_m than vocalisations emitted during daily routine operations (P_m=69.66±8.23 vs 64.44±7.86; C_m=93.09±2.29 vs 95.81±3.01; R_m=2.48±1.25 vs 3.20±2.17, respectively; $p<0.05$). Finally, significant differences were observed for C_m in response to the presence of known (farmer) or unknown persons (94.61±2.50 vs 90.91±3.04, respectively; $p<0.05$). Although further research is required on a larger sample, taking into account also the farm effect, our preliminary results suggest that it is possible to develop an IT tool for automatic classification of goats' vocalisations emitted in different emotional contexts based on different acoustic features.