

## Development of a rumen bolus platform for data acquisition in dairy small ruminants

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Currently available rumen bolus equipped with sensors (e.g., temperature, pH, movement) were developed for cattle monitoring and are unsuitable for small ruminants. This is due to the large size capsules (external diameter, 27 to 35 mm; length, 115 to 145 mm; weight, 70 to 240 g) which makes necessary their implantation by surgery or throughout rumen cannulas. With the aim of solving this limitation, we developed a small rumen bolus (BIOSENS; external diameter, 22 mm; length, 80 mm; weight, 40 g), designed to monitor the rumen temperatures and movements of sheep and goats using an electronic sensing platform. The platform contained an internal sensing device connected to an external receiver by high radiofrequency (programmable and ranging from 433 to 473 MHz). Three main phases were followed for the development of the platform:

- Analysis, design and construction of the internal circuitry, configuring the sensors and optimization of the energy consumption
- Miniaturization of the bolus and control of the power of transmission
- Design and construction of the receiver for a permanent listening of the internal device
- Manufacture of bolus prototypes and tests of encapsulation
- Performance tests of prototypes in a cannulated dairy cow
- Oral administration and performance tests of prototypes in 4 adult dairy sheep

The core of the bolus was based in an ATMEL microprocessor configured for low power operation and powered with by a small cylindrical Li battery (3.3 V, 2.1 Ah, 0.67 A) which proved to be operative for more than 10 mo when logged to a temperature sensor collecting data every 2 min (sampling frequency can be 1/10 s). The radiofrequency signal was able to be transmitted from inside the rumen to a transceiver located at more than 5 m. The platform is open to incorporate other types of internal or external data acquisition devices (e.g., pedometers, subcutaneous sensors) and currently it has been extended to log data from a tri-axial accelerometer to monitor rumen movements of dairy sheep. A total of 100 prototypes are currently being produced to be administered to a flock of dairy sheep during lactation.

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