The Use of Vibration Analysis and Telemetry to Measure Bite Frequency and Intensity in Free-Ranging Horned Ruminants

P R. Lawrence
University of Hohenheim

K Becker
University of Hohenheim

THE USE OF VIBRATION ANALYSIS AND TELEMETRY TO MEASURE BITE FREQUENCY AND INTENSITY IN FREE-RANGING HORNED RUMINANTS

P.R. Lawrence and K. Becker
Institute for Animal Production in the Tropics and Subtropics, University of Hohenheim (480), Stuttgart D-70953, Germany

ABSTRACT
An apparatus is described which detects and measures the vibrations in a ruminant's horn especially those produced by the animal's teeth. Vibrations are transmitted by radio to a portable computer where those produced as a result of eating and ruminating can be characterised by their intensity, length and frequency.

KEYWORDS
Eating, ruminating, piezo-electric, bite meter, vibrations, telemetry

INTRODUCTION AND METHOD
This paper describes a method of monitoring the eating behaviour of horned ruminants by measuring the vibrations transmitted to the horns when the animal's teeth grind together. Previous devices for monitoring eating behaviour have measured the jaw movements of the animal using electro-mechanical, pneumatic (Brun et al., 1984) or variable resistance sensors (Matsui and Tadakatu, 1991) attached round the animal's mouth. These sensors can impede the animal's feeding behaviour and are easily damaged. The present system uses a piezo-electric vibration sensor attached firmly by a strip of rubber underneath and near the base of the animal's horn. In this position, it can pick up vibrations from the teeth which are transmitted through the bones of the skull while being remote from the animal's mouth and protected from physical damage.

The sensor produces an AC signal having a maximum amplitude around 1000Hz. The signal is processed by a circuit housed in a small box placed at the back of the animal's head and held in place by straps round both horns. Power for the device comes either from two small 9V batteries attached to the box or, more usually, from two rechargeable 12V batteries placed in bags attached to a body belt on either side of the animal.

The initial signal is amplified and filtered to restrict frequencies to 300-3000Hz to prevent pick up of interference from low frequency or radio sources. The signal is then converted to a digital frequency proportional to the input analogue voltage and transmitted by radio from the animal to the parallel 'printer' port of a 486DX IBM compatible laptop computer. No modification of the computer such as the addition of an expansion board is required. A program written in Microsoft QuickBasic version 4.00 accepts incoming data and decides which sets of vibrations constitute bites on the basis of constants, the value of which are input by the user. It then stores the number of vibrations in each bite (a measure of bite intensity), the length of the bite in seconds and its time of occurrence in an ASCII file which can later be analysed using other programs such as commercial spreadsheets.

RESULTS
Figure 1 shows the results from a Hinterwälder ox eating hay. The program not only records groups of vibrations caused by the grinding of the animals' teeth but also other events such as bellowing, eructation or scratching. These events can in almost all cases be distinguished from bites because of their intensity, length or infrequency of occurrence (Table 1). It is hoped that in future studies, it will prove possible to characterise more precisely the types of vibrations produced by these events so that the vibration monitor can be used to study activities other than eating and ruminating.

REFERENCES
Brun, J.P., S. Prache and A. Bechet. 1984. A portable device for eating behaviour studies. Fifth meeting of the European grazing workshop, 25 October, 1984, Edinburgh.

Matsui, K and T. Okubu. 1991. A method for quantification of jaw movements suitable for use on free-ranging cattle. Applied Animal Behaviour Science, **32:** 107-116.

Table 1
Characteristics of bites of an ox eating and ruminating hay and bite-like events that occurred while loafing.

Animal activity	Intensity factor	Length of event (s)	Time between events (s)
Eating	179 ± 66	0.24 ± 0.07	1.21 ± 2.28
Loafing	392 ± 323	1.28 ± 7.58	12.83 ± 22.7
Ruminating	208 ± 67	0.26 ± 0.06	1.22 ± 0.9

Figure 1
Bite intensity and frequency of an ox fed hay while eating and ruminating and bite-like events while loafing