BRIEF COMMUNICATION: Optimizing a fasting protocol to assess live weight of sheep

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Introduction

Measurement of live weight is prone to variation from a number of sources. The largest of these is likely to be the weight of digesta in the rumen, which can contribute up to 17% of the measured live weight, and is influenced by a number of factors associated with both animal grazing behaviour and feed characteristics (Hughes 1976; Orr et al. 1997; Gregorini 2012). Accounting for the potential variation in liveweight estimates caused by gut fill may therefore provide greater accuracy of liveweight records. It may be expected that the variation in liveweight estimates caused by gut fill can be reduced through fasting, with periods of 24 h typically used. For commercial farmers who collect liveweight information either to assist with management decisions, determine the nutrient status (van Burgel et al. 2011) or pregnancy status (Judson & Nicol, 1993) of ewes, this length of time may be unacceptable. Given that live weight continues to decline even after 48 h fasting (Warriss et al. 1987), the error associated with gut fill is unlikely to be completely eliminated. Fasting for shorter periods may be able to reduce the variation in liveweight estimates caused by gut fill to assist obtaining liveweight measurements within a time frame that is acceptable for use in commercial situations. However, there is a paucity of published data surrounding the variation in liveweight estimates with time of fasting. The objective of this study was to quantify the variation in liveweight estimates at varying times of fasting and identify the minimum fasting time required in order to develop appropriate fasting and weighing protocols for commercial situations.

Materials and methods

General methodology

The live weight of 100 mixed-age ewes that were maintained under normal farming practice was repeatedly recorded, following removal from pasture and 24 h fasting, in the weighing protocol described below. All animals were previously tagged with sheep lightweight electronic radio-frequency identification (RFID) ear tags (Allflex Ltd, Auckland, New Zealand). Live weight was logged using an automated weighing and drafting platform (Prattley Industries Ltd, Temuka, New Zealand) fitted with electronic weigh load bars (Tru-test, Auckland, New Zealand) and a portal electronic tag reader (model No.S03071, Prattley Industries Ltd, Temuka, New Zealand). Animal identification and weights were automatically recorded on a Tru-test XR3000 head unit (Tru-Test Ltd, Auckland, New Zealand) at a sensitivity of 0.2kg.

Weighing protocol

The weighing protocol described below was carried out at three weighing events: time of removal of the ram in April, immediately following weaning in December and one month post-weaning in January. Forty-eight hours prior to each weighing event, all animals were shorn to remove fleece weight as a variable, before being returned to pasture. For each weighing event, all animals were yarded two hours after sunrise (0 h) and fasted without access to water for the following 24 h. Weights were recorded at 0 h and every two hours until 12 h and again at 24 h fasting. To reduce scale error, the live weight of each individual was recorded three times at each weighing time with a maximum of 15 min between each record. No effort was made to influence the order in which animals were weighed.

Statistical analysis

As the true live weight of an animal can only be estimated, the mean of three live weights for each individual at each measurement time was used, as this represented the best estimate of the live weight. Deviation from the mean weight at 0, 2, 4, 6, 8, 10, and 12 h fasting for each individual was compared with their mean 24-h-fasted weight. Probit analysis using GENSTAT statistical package (version 13.3, 2010, VSN International Ltd) was used to determine the range (kg and %) which encompassed 95 percent of records compared with the 24-h-fasted weight for each fasting time at each weighing event. Using each weighing event as a replicate, the range of weight was compared across fasting times with a one-way ANOVA (MINITAB®, version 16, 2010, Minitab Inc., USA). Post-hoc comparisons using a Tukeys test at a 5% threshold were made to determine the change in variation relative to fasting time.

Results and discussion

Fasting reduced the variation in the recorded live weights. The range of weights which encompassed 95% of the population compared with the 24-h-fasted live weight decreased linearly with time (Table 1). The variation in liveweight estimates was reduced by around two-thirds following 12 h fasting irrespective of whether the range was expressed in absolute weight or as a proportion of the 24-h-fasted live weight. Presumably this reflects excretory and urination behaviour and evaporative losses, all of which may be associated with changes in gut-fill and its contribution to the error in liveweight measurements (Hughes, 1976). Importantly, the current results indicate that the variation in liveweight measurements was reduced by around 40% after 6 h fasting, a point from which no further significant decreases in the variation or in the weight estimates themselves was observed. This allows the suggestion that there is little advantage in fasting for periods of greater than 6 h in order to reduce the variation caused by gut fill. However, this assessment relies on a presumption that a 24–h-fasted weight is an accurate estimate of live weight. On the one hand, it is unlikely to be the case as a parallel slaughter study demonstrated that animals of a comparable age and size to those used in the current study still retained 5.06 kg of digesta, constituting 9% of their true body weight following 24 h fasting (Wilson 2014). On the other hand, previous fasting studies in lambs have shown 100% of individuals to have a 24-h-fasted weight within 1% of their best estimate of true live weight, indicating that fasting for this length of time does reduce the variability in live weight measurements (Galwey et al. 2013).

Table 1 Mean ± sem of live weight and the variation relative to 24-h-fasted weights (range) in both absolute weight (kg) and as a proportion of 24-h-fasted live weight (% 24 h fasted LW) which encompassed 95% of the population relative to time of fasting for mixed-age ewes.

Fasting time (h)	Live weight (kg)	Range (kg)	Range (% 24 h fasted LW)
0	70.9 ± 0.92^{a}	7.43 ± 0.629^{a}	10.40 ± 0.554^{a}
2	70.0 ± 0.82^{ab}	6.34 ± 0.630^{ab}	9.11 ± 0.812^{ab}
4	69.3 ± 0.72^{ab}	5.46 ± 0.609^{abc}	7.85 ± 0.852^{abc}
6	68.4 ± 0.63^{abc}	4.48 ± 0.638^{bcd}	6.60 ± 0.977^{bcd}
8	67.7 ± 0.91^{abc}	3.72 ± 0.673^{bcd}	5.48 ± 0.953^{bcd}
10	67.2 ± 0.59^{bc}	2.94 ± 0.394^{cd}	4.40 ± 0.605^{cd}
12	66.8 ± 0.58^{bc}	2.53 ± 0.317^{d}	3.39 ± 0.645^{d}
24	65.2 ± 0.57^{d}	-	-

Within columns, values with common superscripts are not significantly different ($P>0.05$)

Although gut-fill may still provide a considerable contribution to the measured live weight even after 24 h fasting, this information must be considered in the context in which it is intended. The objectives of the study were to provide information on how fasting can reduce the variation in live-weight measurements in sheep and develop a fasting protocol appropriate for commercial situations. Collection and analysis of individual live-weight information on-farm is likely to increase in frequency with the use of tools such as RFID and either used to assist with management decisions or provide information for collation in genetic or benchmarking databases. It appears that consideration of a standardized fasting protocol will assist in reducing the variation in such data collected. With this in mind, gut-fill can be influenced by both feed type and time of day due to the diurnal pattern of grazing behaviour (Hughes 1976; Orr et al. 1997; Gregorini 2012). While the latter can be expected to be accounted for in the current study through starting the fasting time relative to sunrise, investigation of the influence of feed type was beyond the scope of this investigation. It remains to be determined if the minimum fasting time of 6 h reported here is conserved if fasting were to begin at different times of the day or with animals grazing different feed types.

In summary, fasting for a minimum of 6 h can substantially reduce the variation in live-weight measurements relative to 24-h-fasted weights. It is suggested for commercial situations that consideration of a standardized fasting protocol may help ensure the quality of live-weight data, especially when accuracy of the live-weight measurements is needed.

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