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Comparative behaviour studies of growing dairy and beef bulls from two different breeds

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ABSTRACT. This study aimed at comparing the behaviour of growing bulls from two different breeds – Lithuanian black and white (dairy cattle breed, n=22) and Aubrac (beef cattle breed, n=17). The hypothesis tested in this study was that breed differences would result in differences in the behaviour of the bulls and that a clear understanding of such differences could lead to improved husbandry to meet their needs. Animals were raised in insulated barn in pens with deep litter, both breeds under similar conditions (animals were 11 to 14 month old, each group in separate 100 m^2 pen). Aubrac bulls spent more time in standing, ruminating, drinking and aggressive behaviour and less time in eating than the Lithuanian black and white bulls. There were no significant differences in lying and moving behaviour. These differences possibly related to different breed of animals, and should inform decision making about the management of the two breeds studied.

Keywords: behaviour; bulls; Aubrac cattle; Lithuanian Black-and-White cattle.

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INTRODUCTION

In order to ensure proper keeping conditions for cattle, to maintain and improve their welfare and the safety of animals and personnel there is a need for some breed-specific information about animal behaviour. Different breeds of cattle can be characterized by different behaviour and temperament attributes (Grandin, 1989; Piovezan et al., 2013). In particular, there are some behavioural differences between dairy and beef cattle (Murphey et al., 1980). There is tendency that cattle of larger size, originating from colder environments, are calmer compared to smaller sized beef cattle breeds found in warmer regions (Grandin and Deesing, 2013). Aubracs are almost the same size as Lithuanian black and white cattle (Piedrafita et al., 2003; Jukna et al., 2006). The Aubrac breed originated from France, a warmer region compared to Lithuania. The Lithuanian Black and White (BW) was developed in the early 20th century by crossing local cattle with Ostfriesian, Swedish Black and White, Holstein-Friesian, and other breeds (Baltrėnaitė et al., 2003). This breed perfectly represents average local European dairy cattle.

Beef husbandry is a newly developing branch of cattle husbandry in Lithuania. At the beginning of 2001, there were only 19 farms keeping 346 purebred beef cows, of which one-third (123) were of the Aubrac breed (Jukna, 2001). By 2015, there were more than 4,000 purebred Aubrac cattle, of which there were about 1,400 heifers, 1,400 cows and 1,200 bulls. Aubracs account for 14 % of all beef cattle raised in Lithuania (Lithuanian centre of agricultural information and rural business, 2016). In Lithuania, there is a tendency to have mixed cattle breed farms, where dairy farmers support the financial viability of their businesses with beef cattle as an additional production source. In such cases, all male offspring of dairy cows are kept in the same conditions as hybrid or purebred beef bull calves. This situation raises some questions about the welfare and behavioural needs of such different animals. Therefore, the objective of this study was to compare the behaviour of growing bulls from two different breeds – Lithuanian black and white (dairy cattle breed) and Aubrac (beef cattle breed) kept under similar conditions. It was hypothesized that breed differences would result in differences in the behaviour of the bulls and that a clear understanding of such differences could lead to improved husbandry to meet their needs.

MATERIAL AND METHODS

The experiment was conducted on the cattle farm of the Institute of Agriculture (Lithuania) in Dotnuva (55° 23’ 42.37”, 23° 51’ 29.4”). Animals were managed according to the Lithuanian regulations regarding the use of animals in scientific experiments. Two groups of 11 to 14 month old bulls, one group of the Aubrac (n=17) and the other group of the Lithuanian Black-and-White breed (n=22) were observed. There was no statistically significant difference between the two groups with respect to age. At the start of the experiment mean weights of the Aubrac and Lithuanian Black-and-White bulls were 372.7±8.9 kg and 296.9±5.7 kg respectively. The bulls of the Aubrac and Lithuanian Black-and-White breeds were housed in the same insulated barn, which consisted of straw-bedded pens in four rows. Animals were kept in group pens with concrete flooring (one pen per group, 100 m^2/pen) on deep straw litter. The lying area was cleaned out once at the end of the finishing period. All bulls were fed the same diets based on grass silage and barley-based concentrates. Pen measurements (10 m × 10 m) and feed trough widths (10 m) were the same for both groups. Aubrac bulls had a space allowance of 5.88 m^2 per bull while black and white bulls had 4.55 m^2 per bull. This was slightly higher than the current minimum recommended space allowance for beef cattle in this type of housing in Lithuania (4 m^2 per animal, Lithuanian Ministry of Agriculture, 2009). Bearing in mind that the Aubracs were heavier, space allowance per kg of live weight was 0.0158 m^2 for Aubracs and 0.0153 m^2 for black and white bulls, so that conditions similar for both groups.

The behaviour of the bulls was observed for a period of 24 hours (00:00–24:00 hours) in June. Average air temperature indoors was 16^{0}C, and relative humidity was 75%. The bulls were observed using instantaneous sampling (Dawkins, 2007) with a 5-min sampling interval. At each

Table 1. Description of postures and activities recorded during instantaneous sampling observations.

Behavior	Description
Lying total	Lying in any position.
Feeding at the feeding trough	Eating and masticating silage or barley at the feeding trough.
Drinking	Drinking water from the bowl.
Standing ruminating	Chewing cud in a standing position.
Lying ruminating	Chewing cud in a lying position.
Moving	Walking without interaction with feed or bedding
Standing idling	Standing without any apparent activity.
Lying resting	Lying without any apparent activity in any position with trunk in contact with ground. Includes sleeping.
Aggressive	Interactions between at least two animals, involving head to head contacts (Bouissou et al.2001)

sampling point each bull was scanned and the posture and activity of the bull were registered according to the classification method and descriptors presented in Table 1 (Tuomisto et al., 2015).

The results are presented in absolute and relative terms (min, %). Behavioral data obtained from scan sampling were expressed in minutes assuming that each behaviour persisted for the entire 5-minute scan interval. Values were expressed as means ± SEM. Mean comparisons were made using the Student two-sample unequal variance (heteroscedastic) t-test with a two-tailed distribution. A t-test's effect size was calculated as Cohen's d coefficient. Results were considered statistically significant at $P < 0.05$.

RESULTS

Frequencies of the observed behaviours are presented in Table 2.

There were no significant differences between the two groups of animals as regards their frequencies of lying and moving behaviours. Aubrac bulls spent more time standing, ruminating, drinking and less

Fig 1: Lying behaviour of the Lithuanian Black-and-White and Aubrac bulls in the course of 24 hours.

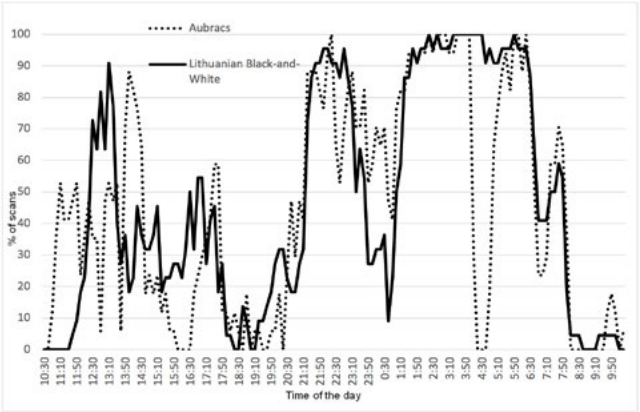

Figure 1. Lying behaviour of the Lithuanian Black-and-White and Aubrac bulls in the course of

time eating than the Lithuanian black and white bulls. Despite the fact that there were no significant differences in lying behaviour frequencies, Lithuanian black-and white bulls spent more time lying with less lying bouts compared with the Aubrac bulls (Table 2). The bulls of the Aubrac breed were distinguishable by more frequently expressed aggressive behaviour in the group. The mean time per animal spent in aggressive

Table 2. Behaviors of Aubrac and Lithuanian black-and-white bulls kept indoors.

Measures	Lying		Moving	Standing			
	Resting	Ruminating		Idling	Ruminating	Eating	Drinking
Aubracs n=17							
minutes per animal per day	321	332		247	154	295	24
	652		68	720			
No. of lying bouts per day	9						
% of scans during 24 h period	22.3 ±1.8	23.0 ±1.6	4.7 ±0.9	17.2 ±1.5*	10.7 ±1.1*	20.5 ±2.0*	1.6 ±0.3**
	45.3 ±3.0			50.0 ±2.8			
Lithuanian black and white n=22							
minutes per animal per day	294	383		180	113	390	10
	677		71	692			
No. of lying bouts per day	6						
% of scans during 24 h period	20.4 ±1.8	26.6 ±1.7	5.0 ±0.8	12.5 ±1.1	7.9 ±0.8	27.1 ±2.3	0.7 ±0.2
	47.0 ±3.0			48.0 ±2.8			

* $P < 0.05$; ** $P < 0.01$

behaviours accounted for 4.2% of the total time in 24 hours (39 encounters between two or more bulls) compared with a mean of 1.5% of time (21 encounter) for the Lithuanian black-and white bulls (data not presented in the table).

There were no statistically significant differences between the breeds regarding any of the diurnal fluctuations in behaviours analysed. Bulls of both breeds expressed a clear diurnal rhythm - during the night almost all bulls spent most time lying (Figure 1) and during the day, most time was spent performing other behaviours. During the period between 20:30 and 8:00 Aubrac bulls spent a little less time lying (70.4 % of observations, Figure 1) than the Lithuanian Black-and-White bulls (73.1 % of observations, p=0.58, Figure 1). The same tendency was observed during the daytime e.g. during the period between 8:10 and 20:20 Aubrac bulls spent a little less time lying (21.5 % of observations, Figure 1) than the Lithuanian Black-and-White bulls (22.3 % of observations, p=0.84, Figure 1). During the period between 8:00 and 12:20, most Lithuanian Black-and-White bulls (average 63 %) spent their time eating (Figure 2). Later, between 12:30 and 13:20 most of these bulls (average 65 %) started to ruminate in lying position. Meanwhile Aubrac bulls started to eat at 8:20 and most animals (average 72 %) spent their time eating until 9:50 (Figure 2). Later eating activity was combined with ruminating and idling behaviours in an irregular manner. The most significant differences in lying behaviour was observed in the period between 14:40 and 16:30, when there were only 0-23.5 % (average 10.3 %) of

Fig 2: Feeding behaviour of the Lithuanian Black-and-White and Aubrac bulls in the course of 24 hours.

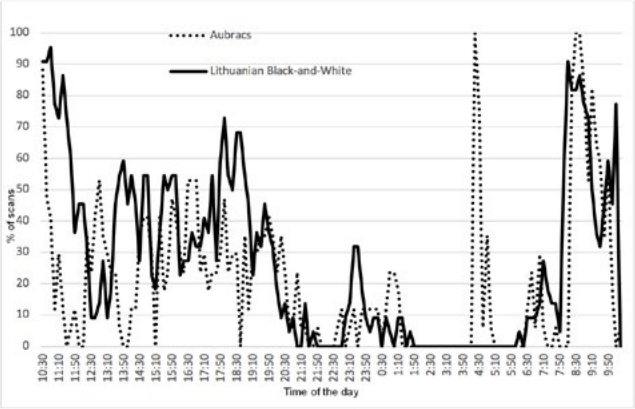

Table 3. Synchronization of behaviors among individuals of each breed, observed at different percentage categories of scans showing the same posture (standing/moving or lying).

Animals	Amount of scans, %			
	70	***80***	***90***	***95***
	% of animals showing the same posture			
Lithuanian BW bulls	74.3	60.4	48.6	38.9*
Aubrac bulls	75.7	60.4	39.6	25.0

* $P < 0.05$

Aubrac bulls lying compared to 18-50 % (average 30.7 %, P < 0.01) of the Lithuanian Black-and-White bulls (Figure 1). Effect size (expressed as Cohen's d coefficient) for statistically significant differences is 0.3.

Behaviour synchronization of the observed animals was not statistically different at the 70 and 80 % scan levels (Table 3). At the 90 and 95 % thresholds, behaviour synchronization of Aubrac bulls was lower compared to that of the Black-and-White bulls. This means that 90% (and more) and 95 % (and more) of Aubrac bulls were observed showing the same posture (lying or not lying) at 39.6 and 25 % of all observations, while 48.6 and 38.9 % of observations of Lithuanian Black-and-White bulls showed behavioural synchronization from 90 and 95% of the scans made.

DISCUSSION

In this study, the behaviour of the bulls from two different breeds (Lithuanian black and white and Aubrac) in insulated barn in pens with deep litter were compared.

The study showed a clear diurnal rhythm of cattle behaviour, which was similar to that found by Robért et al. (2011). They found that most cattle lay between 20:00 and 04:00. In this study, it was found that most of the Aubrac bulls spent their time lying in the periods between 21:00 - 04:00 and 05:00 - 07:00. Most Lithuanian black and white bulls spent their time lying in the periods between 21:00 – 24:00 and 01:00 – 07:00 that is during the dark period of the day. There were clear periods of activity caused by the morning (08:00) and evening (18:00) feeding periods of the animals. Therefore, in our study, we observed a clear overall drop in activity during the nighttime (with some differences between breeds) and a rise in activity during the light period of the day and during the feeding period of the animals.

It was found that total lying times of the Lithuanian black and white and Aubrac bulls were 652 and 677 min per day respectively (p>0.05). Absmanner et al. (2009) found that the total lying time of 450-600 kg Simmentals kept in group pens on straw bedding was 780 min. Hickey et al. (2014) found that total lying time of 335 kg Charolaise heifers kept on slatted floors was 768 min. Cook (2008) found that mean lying time of 208 dairy cows in cubicles was 660 min. (168-1056 min.) which was the closest finding for lying timings compared to the findings in the present study.

In the present study, total eating times of Lithuanian black and white and Aubrac bulls were 295 and 390 min per day respectively (p<0.05). Hickey et al. (2014) reported that the total eating time of Charolais heifers was 318 min. Cook (2008) found that the mean eating time of dairy cows in cubicles was 264 min (84-468 min). Gottardo et al. (2003) found that Simmentals (around 321 kg) spent 50% of their time lying, while we report a little less, 45.3% (Aubracs) and 47.0% (Lithuanian BW). Eating and rumination times in this study were similar to those found by Gottardo et al. (2003), 20-30% and between 30 and 40% respectively. Aubrac bulls had nine lying bouts per day (table 2), while the Lithuanian black and white bulls had a mean of six lying bouts per day. These findings are similar to those reported by Hickey et al. (2014), who found that Charolais heifers kept on slatted floors had 6.7 lying bouts and 9.2 lying bouts per day at pasture. Ipema et al. (2010) reported that lying of dairy cows during day was divided over seven bouts, varying in length between 11 and 137 min, and that cows kept in a straw yard had more lying bouts than cows kept in a cubicle barn with slatted floor. One can assume that Aubrac bulls having more lying bouts were more active compared to the black and white bulls. The

Aubrac lying bouts were shorter and interrupted by frequent periods of activity. This may have been related to the higher number of agonistic events among the Aubrac bulls, which could have disturbed the animals from lying.

There were differences in observed aggressive behaviour between the breeds; the Aubrac bulls attacked each other more often compared to the black and white bulls. The mean number of encounters between bulls from both groups was similar to that recorded for 321 kg weight Simmental bulls (Gottardo et al., 2003) – from 10 to 40 times per day. Brscic et al. (2007) reported that the number of agonistic behaviours (fights and mounts) between 508 kg weighing finishing French crossbred bulls was 34.6 per day in hot conditions, 30.5 in mild and 32.3 in cold conditions.

The behaviours of a cattle group are usually determined by the diurnal rhythm (light, feeding, other regular events or farm management activities), individual characteristics or preferences of animals and synchronization of behaviour of the entire group. Cattle have been demonstrated to show synchronization of lying and standing behaviours (Stoye et al., 2012). Such synchronization is identified when cattle lie down or stand up at the same time as other members of their herd. In the present study, it was found that behaviour synchronization of both groups was similar. Most of the animals (70 % and more) showed the same behaviours (lying or standing/moving) in 75.5 and 74.3 % of all scans for Aubrac and Lithuanian Black and white cattle respectively (Table 3). At the 90 and 95 % thresholds, behaviour synchronization of Lithuanian black and white bulls was slightly greater (48.6% and 38.9%) than that of the Aubracs (36.6% and 25.0%, $P < 0.05$, Table 3). It may therefore be assumed that, compared to Lithuanian black and white cattle, some of the Aubrac bulls were more independent of the rest of their herd and were less influenced by the behaviour of other individuals. Social behaviour of cattle (including synchronization) can be influenced by the housing conditions: number of animals kept in the same pen and floor space available to them, quality of surface at the lying place and human-animal relationships (Waiblinger et al., 2001). Lying behaviour could also depend on housing and management conditions (O'Driscoll et al., 2008). Because of differences in housing and management conditions, it is difficult to compare the behaviour synchronization results among cattle that have been reported in different studies.

Stoye et al. (2012) estimated that time of the day has some importance for the synchronization of cattle behaviour. The lowest rate of synchronization was found in the middle of the day, while greater synchronization was found during the morning and evening. In this study, the same effect was observed. In the middle of the day, cattle expressed more diverse behaviours than during the morning, evening and nighttime. Behaviour synchronization, especially lying synchronization can be seen to reflect some degree of comfort and a better social environment for cattle (Phillips and Schofield, 1994). There have been attempts to use cattle behaviour synchronization as a welfare indicator (Miller and Wood-Gush, 1991; Fregonesi and Leaver, 2001; Napolitano et al., 2009) but of the multiplicity of secondary factors such as time of the day, available space, number of animals in the group, other housing conditions and management factors might limit the use of synchronization as a universal indicator for assessing welfare.

Despite fact that total lying time was not significantly different between groups, the bulls of the Aubrac breed had more lying bouts and fewer animals lay during the nighttime. Together with the lower behaviour synchronization score, this allows the assumption that Aubrac bulls might be more individual, less influenced by the behaviour of other animals in the group, than Lithuanian black and white bulls. This kind of behaviour is characteristic of less tame cattle or breeds of animals with a less docile temperament (Grandin and Deesing, 2013).

CONCLUSIONS

Overall, this behavioural study revealed only minor differences in time budgets between the two breeds of cattle. There were no differences in lying and moving between Aubrac and Lithuanian black and white bulls. The Aubrac bulls spent more time in

standing, ruminating, drinking and less time in eating than the Lithuanian black and white bulls. The bulls of the Aubrac breed were distinguished by more frequently expressed aggressive behaviour in the group. These differences resulted most probably from the different temperaments of the two breeds of cattle studied. There is evidence that Aubrac breed cattle are less socially integrated than Lithuanian Black and White cattle. This understanding should inform best practice of the management of these animals.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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