

Behaviour and meat quality of Podolian young bulls

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ABSTRACT - From April to August 2008, twelve Podolian subjects, aged about 11 months at the beginning of the experimental period, were used to evaluate the effect of rearing system (Confined *vs.* Free-range) and season (spring *vs.* summer) on their behaviour and meat quality. Nine sessions of behavioural observations were performed. During a 6-h period, the behaviour of a focal animal, was continuously monitored. In each session a different animal was chosen. All the animals were slaughtered at 18 months of age. Walking ($P < 0.001$) and standing ($P < 0.05$) were lower in summer, whereas inactivity was higher ($P < 0.05$). Free-range bulls spent more time walking ($P < 0.05$), feeding ($P < 0.001$) and standing ($P < 0.01$) and showed a lower number of agonistic ($P < 0.05$) and non-agonistic social interaction than confined animals ($P < 0.01$). Self- and allo-grooming were not affected by rearing system, whereas season influenced self-grooming with higher values in spring ($P < 0.05$). Confined animals showed higher final weights ($P < 0.05$) and a lighter meat ($P < 0.05$), whereas no differences between groups were observed for average daily gains, carcass yield, water holding capacity and a^* and b^* indexes. Confinement markedly affected the behaviour of the animals, whereas free-ranging had only minor negative effects on meat lightness.

Key words: Podolian cattle, Behaviour, Meat quality, Animal welfare.

Introduction - Husbandry of native breeds can provide an opportunity for sustainable use of natural ecosystems and support socio-economic development of marginal areas in southern Italy. A high level of sustainability in terms of human edible returns was found in Podolian cattle and in their farming system (Napolitano *et al.*, 2005). This breed has been subjected to a low selective pressure, as artificial insemination has been rarely used, and it is traditionally kept on pasture. In addition, the extensive rearing system used for these indigenous animals provides a natural environment where they are allowed to express their own proper ethogram, similarly to wild species. As the ancestors of cattle are extinct and no wild cattle breed is available, the Podolian may represent a valid source of information about the behavioural needs of cattle. In fact, extensive production systems let animals to perform most of their innate behaviour patterns, which are deemed essential to assure good welfare. Extensive system may affect meat quality, as some authors found that grazing induced darker meat colour in young bulls (Muir *et al.*, 1998). Colour and water holding capacity influence meat appearance and acceptability and thus consumers' purchasing decisions. Therefore, the present study aimed to evaluate the effect of two rearing systems (confined and free-range) on the behaviour and meat quality of Podolian young bulls.

Material and methods - The experiment was conducted from April to August 2008 in a farm located in Basilicata (southern Italy) at 338m above sea level. Twelve Podolian subjects, aged about 11 months at the start of the experiment (383.33 ± 9.07 kg of average live weight), were divided in two groups: confined (C)

and free-ranging (FG). FG animals were allowed to graze on a natural fenced pasture (18ha of grassland, 2ha of shrub vegetation) until slaughter. They were supplemented with 3kg and 5kg of flour (31% of oat, 31% of barley, 31% of field bean, 3% of linseed, 1% of mineral mix) from April to mid June and from mid June to August, respectively. C subjects were kept in a loose with a straw bedded resting area and an uncovered exercise area (13.4 m²/head). They received 8kg of the same flour and straw *ad libitum*. Behaviour observations were performed in nine sessions through continuous focal animal recording method (Martin and Bateson, 2007). A 6-h period of continuous observations were alternatively conducted from 06.00 to 12.00 and from 12.00 to 18.00. In each session a different animal was chosen. The observed animals were habituated to the presence of humans and could be approached closely (1 - 2 m) without visible influence on their behaviour. The duration (accuracy: 1 s) of the observed behaviours was recorded. The behaviours recorded were the following: posture (standing or lying) and activities (feeding, walking, ruminating, inactivity, alert). The proportion of time spent on each behaviour were calculated for each observation session. In addition, behaviours such as self and allo-grooming, agonistic (pushing, butting or threatening conspecifics) and non-agonistic interactions, drinking, vocalisations and licking were recorded as number of events. The distance covered during the observation session was recorded by means of pedometer. The behavioural observations were divided into two seasons: spring (mid April-mid June; 5 recordings) and summer (mid June-August; 4 recordings). Mean temperatures were 19.8±2.0 and 30.7±2.5°C in spring and summer, respectively. All the animals were slaughtered at 18 months of age. Colour parameters (L, a*, b*) were measured by a colour meter Minolta CR 200 (D₆₅: illuminant) on 1 cm thick steaks, allowed to bloom for 1h. Centrifugation, thawing and cooking losses were assessed (Sodo *et al.*, 2007). Behavioural data were subjected to ANOVA with season, rearing system and their interactions as factors, using the observation session as experimental unit. Data on meat quality were subjected to analysis of variance with one factor (rearing system).

Results and conclusions - The activity budget observed throughout the experimental period is depicted in Table 1. No significant statistical interactions were observed. FG subjects walked longer distances in comparison with C animals (P<0.05). This is closely related to the higher walking (P<0.05) activity and the lower inactivity (P<0.01) observed in FG bulls as compared to group C. These results may be attributed to the fact that grazing animals receive more environmental stimuli for exploration and feeding, as also suggested by the higher feeding (P<0.001) and standing (P<0.01) activities recorded in group FG. In response to high ambient temperature (30°C) walking (P<0.001) and standing (P<0.05) were lower, whereas inactivity was higher (P<0.05) in summer. Group FG showed lower agonistic (P<0.05) and non-agonistic (P<0.01) interactions (Table 2) as possible consequences of reduced competition for resources (food, water, resting areas, etc.) and increased attention to the environment, respectively. Self-grooming was higher in spring. This comfort behaviour is closely related to hygiene and possibly associated to the higher rain falls and body dirtiness usually observed in this season. Object licking was higher in spring and in confined animals (P<0.05). In agreement with Huber *et al.* (2008), the lower object licking observed in FG animals may be explained by the higher walking and feeding activities. Vocalisations were higher in FG animals (P<0.05) and in spring (P<0.05). Vocal signals are used to keep contact with and locate other herd members, therefore they were more frequently expressed in free-range conditions and when animals moved more often (spring).

C animals showed higher final weights than FG subjects (662.75±20.30 vs. 599.47±20.30kg, P<0.05), but no significant differences were observed for average daily gains (1.27±0.10 vs. 1.04±0.10kg for C and FG, respectively) and carcass yields (54.93±0.99 vs. 53.32±0.99%, for C and FG, respectively). No significant differences were observed for centrifugation, thawing or cooking losses (Table 3). L index was higher in the meat of confined bulls (P<0.05), whereas a* and b* parameters did not differ between the groups. Beef from cattle reared on pasture is often darker than beef finished indoors (Muir *et al.*, 1998). Although grazing animals showed lower slaughter weights, we conclude that confinement markedly affected the behaviour of the animals, whereas free-ranging had only minor negative effects on meat lightness.

Table 1. Activity budget (means \pm s.e.) of Podolian young bulls expressed over 6-h periods and recorded in 9 sessions.

	Rearing system (RS)		Season (S)		Significance	
	Confined	Free-range	Spring	Summer	RS	S
Distance travelled, m	599.47 \pm 370.24	1915.85 \pm 370.24	1476.70 \pm 349.07	1038.62 \pm 390.28	0.05	ns
Standing ¹	44.17 \pm 3.87	55.51 \pm 3.87	59.12 \pm 3.65	40.56 \pm 4.08	0.01	0.05
Feeding ¹	14.65 \pm 2.92	36.16 \pm 2.92	29.24 \pm 2.75	21.57 \pm 3.08	0.001	ns
Walking ¹	2.20 \pm 0.68	4.68 \pm 0.68	5.90 \pm 0.64	0.97 \pm 0.71	0.05	0.001
Inactivity ¹	50.90 \pm 4.05	31.23 \pm 4.05	33.87 \pm 3.82	48.25 \pm 4.27	0.01	0.05
Alert ¹	4.14 \pm 2.07	4.12 \pm 2.07	6.83 \pm 1.95	1.43 \pm 2.18	ns	ns
Ruminating ¹	23.73 \pm 2.89	21.95 \pm 2.89	20.11 \pm 2.72	25.57 \pm 3.04	ns	ns
Other ¹	4.38 \pm 0.97	1.85 \pm 0.97	4.03 \pm 0.91	2.20 \pm 1.02	ns	ns

¹Data expressed as percentage of time.

Table 2. Other activities (means \pm s.e.) of Podolian young bulls observed over 6-h periods and recorded in 9 sessions (data expressed as n. of events).

	Rearing system (RS)		Season (S)		Significance	
	Confined	Free-range	Spring	Summer	RS	S
Self grooming	9.02 \pm 1.78	8.60 \pm 1.78	12.50 \pm 1.68	5.12 \pm 1.88	ns	0.05
Allo-grooming	7.80 \pm 1.71	3.75 \pm 1.71	6.30 \pm 1.62	5.25 \pm 1.80	ns	ns
Agonistic interactions	8.17 \pm 1.61	3.00 \pm 1.61	5.30 \pm 1.52	5.87 \pm 1.70	0.05	ns
Non-agonistic interactions	18.62 \pm 1.77	9.95 \pm 1.77	13.70 \pm 1.67	14.87 \pm 1.87	0.01	ns
Object licking	6.55 \pm 1.10	2.47 \pm 1.10	6.40 \pm 1.03	2.62 \pm 1.15	0.05	0.05
Vocalisations	0.55 \pm 0.92	3.40 \pm 0.92	3.70 \pm 0.87	0.25 \pm 0.98	0.05	0.05

Table 3. Water holding capacity (%) and colour of meat (means \pm s.e.).

	Rearing system (RS)		Significance
	Confined	Free-range	
Centrifugation	9.68 \pm 0.91	11.43 \pm 0.91	ns
Thawing loss	1.42 \pm 0.11	1.71 \pm 0.11	ns
Cooking loss	29.47 \pm 0.73	30.07 \pm 0.73	ns
L	34.39 \pm 0.22	33.8 \pm 0.17	0.05
a*	21.72 \pm 0.34	22.43 \pm 0.27	ns
b*	1.77 \pm 0.14	1.90 \pm 0.11	ns

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REFERENCES - Huber, R., Baumung, R., Wurzinger, M., Semambo, D., Mwai, O., Winckler, C., 2008. Grazing, social and comfort behaviour of Ankole and crossbred heifers on pasture in south western Uganda. *Appl. Anim. Behav. Sci.* 112:223-234. Martin, P., Bateson, P., 2007. *Measuring Behaviour*. Camb. Univ. Press, UK. Muir, P.D., Smith, N.B., Wallace, G.J., Cruickshank, G.J., Smith, D. R., 1998. The effect of short-term grain feeding on liveweight gain and beef quality. *New Zeal. J. Agr. Res.* 41:517-526. Napolitano, F., Pacelli, C., De Rosa, G., Braghieri, A., Girolami, A., 2005. Sustainability and welfare of Podolian cattle. *Liv. Prod. Sci.* 92:323-331. Sodo, A., Napolitano, F., Girolami, A., Pacelli, C., Piazzolla, N., Braghieri, A., 2007. Impiego del favino per la produzione di carne bovina biologica: colore e potere di ritenzione idrica. *Proc. of 3rd Workshop GRAB-IT*, 159-163.