Effects of Pair versus Individual Housing on Romanian Simmental x Limousine Crossbreed Calves Behaviour

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Abstract
The aim of the study was to assess the effects of housing method on Romanian Simmental x Limousine (RS x L) crossbred calves behaviour. To investigate these effects 12 RS x L calves were separated from damns within the first hour after birth and were housed either individually (n=6) or in pair (n=3 pairs) on straw bedded pens. The inactive standing, habitat exploring and playing behaviours were recorded on days 15, 30, 45 and 60 after birth. Individually housed calves spent more time ($P \leq 0.016$) standing inactive (means ±SEM) 5.16±0.47 bouts / day compared to pair housed calves (3.12±0.57 bouts / day). In gregarious animals, presence of a partner reduces stress and fear due to the social isolation. The pair housed calves spent significantly less time ($P \leq 0.039$) to explore the habitat (3.5±0.56 bouts / day) compared to individually housed calves, which resulted in higher frequency of exploration bouts (5.83±0.79 bouts / day). Also, paired calves spent more time ($P \leq 0.001$) in social contact, playing with the partner (4.16±0.7 bouts / day) compared with individually housed calves (0.16±0.06 bouts / day). These results indicate that housing calves in pairs generated benefits for calves such as better welfare condition, social opportunities and expression of desired behaviours patterns.

Keywords: housing method, crossbreed calves, welfare, behaviour

1. Introduction

The current economic situation and in particular the fluctuations occurred on milk market induce reconversion of more and more specializing milk farms to meat production. Quantitative and qualitative consumer's requirements have increased in the last years. Farmers and suppliers will have to meet consumer's needs in order to solve this issue. Rearing the crossbred calves (local breeds and beef breeds) becomes more expanded. Increasing the efficiency in crossbreed rearing is largely dependent upon the individual and group welfare condition, due to the different response to external stimuli, and according to breed and productive type [1]. Age and physiological category may have significant impact on cattle physical or mental response, most affected being new born calves and cows after calving [2]. Industrial rearing systems, substantially alter the environmental conditions than those provided by the natural habitat. Calves welfare is obviously depreciated in terms of health, behaviour and productive performances, irrespective of their breed and productive type. However, the anthropogenic habitat cause stress since birth, through the separation from dams.

Individually housing constitutes an easy way to monitor the growth [3] and to limit the incidence of unwanted events [4, 5]. Moreover, reduced *E. coli* contamination due to dirty straws used in common [6], decreased the incidence of digestive disorders [7]. Another positive aspect of individually housing is limiting disease incidence, decreased mortality [8, 9] and morbidity in calves

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[10], although other studies have not recorded differences in this respect, between individually and pair housing [11]. Individually housed calves recorded an increased growth rate than paired [7] inconsistent with previous outcomes obtained by Roy JHB (1990) [12]. Not lastly, individual housing provides the premises of docile cattle at milking or in animal-human relationship [13]. Pair housing allows the reduction of labour input (for nursing, feeding, refresh the straw beddings) and space requirements [14]. Moreover, paired or small group housing (3-6 head) allows development and externalization of some specific age category behaviours with significant impact in providing of welfare condition or as indicators of its (ingestion, exploration, playing behaviour) while reducing unwanted events (agonistic behaviour) or unwanted emotions as fear, frustration, anxiety [15].

Numerous studies available in literature were conducted on dairy breeds. Nowadays, there is a serious lack of information regarding beef breeds and especially their crossbreds. Due to a high expansion of cross-breeding (of local breeds with beef breeds) in order to obtain an increasing numbers of crossbred calves, is important that rearing systems to be adapted to their needs, to ensure a suitable environment for externalize their genetic productive potential. The results generated by this current study will provide information about the crossbred calves needs according to housing.

The aim of the study was to assess the effects of housing method on Romanian Simmental x Limousine (RS x L) crossbred calves behaviour.

2. Materials and methods

The study was carried out in livestock farm from the Research and Development Station for Bovine Arad, Romania (location: 46° 10' 36" N, 21° 18' 4" E, 107 m altitude, 582 mm annual average rainfall, and 21°C / -1°C average of temperature corresponding to summer / winter seasons). In the current study 12 RS x Lim crossbred calves (4 females and 8 males) were randomly included. Calves were from eutocic (n = 12), singles (n = 10) or twins calvings (n = 2 calves). Calves were separated from their dams within the first hour after birth and moved either individually (1.85 x 1.85 m, n=6) or in pairs (3.2 x 2.2 m, n=3 pairs) in straw-bedded pens, in the maternity until 14 days of age. Calves were feed with whole milk 6 L / day and pre-starter from day 5 (18.15 CP, 2510 Kcal/Kg). From day 14 to 60 the crossbred calves were housed outside the maternity barn. The calves were feed with milk replacer 6 L /day (95% DM, 22% PC, 18% Fat), alfalfa hay (84% DM, 13% PC) and concentrates (88% DM, 17% PC, 2.5% Fat) *ad libitum*. After 60 days of age, all the calves were moved in group pens (6 heads / box) up to weaning (100 days of age). Calves had constantly visual and auditory contact with congeners from neighbouring pens, both in maternity and in external facility. The calves were pre-weaned between day 90 and 100, all calves being totally weaned at 100 days of age. For crossbred calves, we recorded several types of behaviour: inactive standing (minimum 10 seconds), exploring the habitat (sniffing the walls or any parts of pen, extend their neck over the pen or extend the head through the frontal openings of pen) and playing behaviour.

Behaviour patterns were recorded for 24 hours on days 15, 30, 45 and 60 after birth, using 4 cameras (Sony HDR-CX24OE) and analyzed by The Observer XT specialized software. Comparisons between calves were carried out using the one way ANOVA protocol, with categorical factor being considered the housing method. All the statistical inferences were carried out using Statistica® software v. 13 [16]. Decisions about the acceptance or rejection of statistical hypothesis have been made at the 0.05 level of significance.

This research was mainly observational and non-invasive. Ethical considerations of this study were evaluated according to the European Union's Directive for animal experimentation (Directive 2010/63/EU) and were approved by the Scientific Council at the Research and Development Station for Bovine Arad (No.50/29.10.2015).

3. Results and discussion

Significant differences ($P \leq 0{,}016$) were recorded related to inactive standing bouts frequency according to housing (Table 1). Individually housed calves spent more time standing inactive (5.16±0.47 bouts / day) than paired calves (3.12±0.57 bouts / day). Inactive standing was observed mainly in three situations: before feeding, at feeding time of other animal categories due to the noise made by machinery used, and after certain operations that were not included in

daily routine. Individually housed calves showed an increased insecurity state compared to those housed in pairs. A significant correlation coefficient was calculated between inactive standing and exploring bouts (R=0.39) for individually housed calves, while this correlation coefficient was lower (R=0.1) for pair housed calves.

The frequency of inactive standing bouts was influenced by number of animals in the group; a large number of individuals reduced the frequency. The results are consistent as the previous ones obtained by Faerevik Gry (2007), 4.3±0.7 bouts in 4 calves group, 1.2±0.6 in 16 calves group, respectively, for Red Danish breed [17]. Chua B. (2002) obtained inconsistent results from a study conducted on Holstein Friesian pair housed calves, in which recorded an increase in inactive standing bouts frequency of 4.77±0.34 bouts / day compared to individually housed calves 3.33±0.4 bouts / day [18]. Pair housing has reduced the time spent by Holstein Friesian calves standing inactive in a study conducted by Hanninen L. (2007) [19].

Table 1. Mean (±SEM) of calves' behaviour patterns according to housing

Behaviour	Individual	Pair
	BR x Lim	BR x Lim
Inactive standing*	5.16±0.47[a]	3.12±0.57[b]
Explore environment*	5.83±0.79[a]	3.5±0.56[b]
Playing*	0.16±0.16[a]	4.16±0.7[b]

Rows with different superscript differ significantly at $p \leq 0.05$
*bouts / day

The inactive standing was significantly influenced by the social contact between calves. In the current survey, calves have permanent visual and auditory contact with others. Pair housed calves initiated more social contacts with partner that have led to a reduced frequency of orthostatic inactive position, results confirmed by Duve and Jensen (2011) [20]. Calves prefer to rest lying down. In the pasture, calves adopt standing posture in windy - wet weather [21]. In pen housing, calves are standing inactive when there are nearby noises activities. In such cases the calves are either bothered or curious about. Flooring comfort influenced the frequency of orthostatic and resting posture alternation. Hard concrete floor or a floor covered by a thin layer of straw increased the time spent by calves standing inactive, also frequency of standing up and lying down alternation [22]. Inappropriate flooring can increase incidence of legs injury [23]. Fortuitous adoption of standing posture is to be avoided, this powerful motivating calves to rest in lying position, being able to give up feeding [24]. De Wilt (1985) suggested that a longer standing time for calves housed in pairs or groups compared to those individually housed, could be explained by the greater variety of stimuli [25]. Thus, pair housing could result in more social stimulations, and also more disturbances. Results from the current survey showed that the increased activity in pair housing could be explained by a higher frequency of exploring bouts.

Exploratory behaviour is an instinctive ethological particularity in calves. Through this behaviour calves identifies sources of water and feed, resting areas or potential sources of danger [26]. Individually housed calves showed an increased exploratory activity (5.83±0.79 bouts / day, Table 1)). Pair housing led to a significant decreased ($P \leq 0.039$) exploratory bouts frequency (3.5±0.56 bouts / day). These outcomes are inconsistent with those obtained by Faerevik (2007) who found no significant correlation between group size and exploratory behaviour (3.4±0.9 for group of 4 *vs.* 3.2±0.9 for group of 16 calves) [17]. In pen housing, calves spent more time exploring which could be associated with search for grazing [27]. Decrease of time spent exploring the habitat can increase the time spent by calves feeding or resting particularly in *ad libitum* feeding, such it was the case in our study. However, cognitive processes necessary for adapting to the habitat are easier to accomplish in pairs or groups than in individually housed calves [28]. Exploratory behaviour patterns provide clues related to calves secure / insecure state, according to either environment or stockpersons [29]. Thus, a good human-calves relationship and calm and patiently

handling provide calm animals while reducing the exploratory bouts frequency. Individually housing favours unwanted behaviours after the relocation. Thus, individually housed calves showed a longer latency to socially interact with others calves with an important share of agonistic patterns. The frequency and length of exploring bouts were higher. Pair housed calves showed a less exploring activity, being much calmer and available for non-agonistic interactions [30].

Playing behaviour is an indicator of calves' welfare. In individual housing only a single playing bout (0.16±0.16 bouts / day, Table 1)) was recorded consisting in jumping, hind leg kicking, body and head rotations and twists. Individually housed calves spent more time playing with the straw-bedding, in particularly within the first 10-20 minutes after the provision of fresh straw [31]. Pair housed calves showed an increased interaction (4.16±0.7 bouts / day, $P \leq 0.001$), performed playing activities consisting in running with sudden change of direction, jumping with rotations of the head directed toward the playing partner and physically contact. The presence of a partner stimulated the playing behaviour. Pair housed calves recorded an increase frequency of playing bouts. They were motivated to play because their needs (for food, safety, rest) have been met. These results are consistent to those found by Held and Spinka (2011) [32]. Play behaviour is affected by energy intake from forage [33]. Satiety state provides an increase frequency and duration of playing bouts in calves. Thus, calves feed with higher milk allowance 12 L / day [34] or 9 L / day [33] showed increased frequency and duration of playing bouts than restricted-feed calves (6 L / day). Reducing the milk allowance in pre-weaned period or abrupt weaning is a stressful operation proved by decrease in playing bouts frequency [35]. In the current survey, feeding with constant milk allowance (6 L / day) proved to be a good option for reducing the weaning stress. Playing behaviour in calves' herds recorded a high day to day variation irrespective of housing method used, either individually or herd level. The current study recorded an increased playing activity between 10-12 A.M. with a high variability (41%), consistent to previous results obtained by Mintline (2012) [36].

4. Conclusions

The housing method exerts the same influences on calves' regardless of breed. Pair housing meet calves psychological needs, leads to a significant decrease of inactive standing and exploring bouts frequency. Paired housing stimulates the non-agonistic social contacts and also playing behaviour as indicators of calves' welfare.

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References

1. http://www.animal behavior.net/cattle
2 von Keyserlingk M.A.G., Daniel, M. Weary, Maternal behavior in cattle. Hormones and Behavior. Reproductive Behavior in Farm and Laboratory Animals 11th Annual Meeting of the Society for Behavioral Neuroendocrinology, 2007, 52(1), pp. 106-113
3. Le Blanc, M.M., Management of calf programs, Vet. Cli. of North America Large Anim. Pra., 1981, 3, 435
4. Maatje, K.J., Verhoeff, W.D.J., Kremer, A.L.M., Vruijsen, T.S.G.A.M., van Ingh, Automated feeding of milk replacer and health control of group-housed veal calves, 1993, Veterinary Record, 133, 266–270
5. Tomkins, T., Loose-housing experience in North America. Proc. of the Int. Symp. on Veal Calf Production. EEAP, Wageningen, The Netherlands, 1991, pp. 67–70
6. Garber, L.P., Wells, S.J., Hancock, D.D., Doyle, M.P., Tuttle, J., Shere, J.A., Zhao, T., Risk factors for fecal shedding of Escherichia coli O157:H7 in dairy calves, Am. Vet. Med. Assoc., 1995, 207(1), 46-9
7. Quigley, J.D. 3rd, Martin, K.R., Bemis, D.A., Potgieter, L.N., Reinemeyer, C.R., Rohrbach, B.W., Dowlen, H.H., Lamar, K.C., Effects of Housing and Colostrum Feeding on the Prevalence of Selected Infectious Organisms in Feces of Jersey Calves, J. of Dairy Sci., 1994, 77(10), 3124–3131
8. Lance, S.E., Miller, G.Y., Hancock, D.D., Bartlett, P.C., Heider, L.E., Moeschberger, M.L., Effects of environment and management on mortality in preweaned dairy calves, J. Am. Vet. Med. Assoc., 1992, 201(8), 1197-202
9. Gulliksen, S.M., K.I., Lie, T., Løken, O., Østerås, Calf mortality in Norwegian dairy herds, J. of Dairy. Sci., 2009, 92(6), 2782–2795

10. Fourichon, C., Beaudeau, F., Seegers, H., Critical points related to lousing and management in control programmes for calf morbidity and mortality in France dairy herds. In Ninth International Congress on Animal Hygiene, Helsinki, Finland, 1997, pp. 32-35
11. Hänninen, L., H., Hepola, J., Rushen, A.M., de Passillé, P., Pursiainen, V.-m., Tuure, L., Syrjälä-qvist, M., Pyykkönen, H., Saloniemi, Resting Behaviour, Growth and Diarrhoea Incidence Rate of Young Dairy Calves Housed Individually or in Groups in Warm or Cold Buildings, Acta Agriculturae Scandinavica, Section A- Animal Science, 2003, 53(1), 21-28
12. Roy, J.H.B., The Calf. Vol. 1. Management of Health. Butterworths, Boston, MA., 1990
13. Arave, C.W., C.H., Mickelsen, J.L., Walters, Effect of Early Rearing Experience on Subsequent Behavior and Production of Holstein Heifers, J. of Dairy Sci., 1985, 68(4), 923-929
14. Kung, L.Jr., S., Demarco, L.N., Siebenson, E., Joyner, G.F.W., Haenlein, R.M., Morris, An evaluation of two management systems for rearing calves fed milk replacer, J. Dairy Sci., 1997, 80, 2529–2533
15. Jensen, M.B., Klaus, S.V., Christian, C.K., Play behaviour in dairy calves kept in pens: the effect of social contact and space allowance, Appl. Anim. Behav. Sci., 1998, 56(2–4), 97–108
16. Hill, T., Lewicki, P., Statistics: Methods and Applications. StatSoft, Tulsa, OK, USA, 2007
17. Færevik, G., Andersen, I.L., Jensen, M.B., Boe, K.E. Increased group size reduces conflicts and strengthens the preference for familiar group mates after regrouping of weaned dairy calves (Bos taurus), Appl. Anim. Behav. Sci., 2007, 108, 215-228
18. Chua, B., Coernen, E.J. van Delen, D.M., Weary, Effects of pair versus individual housing on the behavior and performance of dairy calves, J. Dairy. Sci., 2002, 85, 360-364
19. Hänninen, L., (2007). Sleep and rest in calves relationship to welfare, housing and hormonal activity, Academic dissertation by Kelsinki, 2007
20. Duve, L.R., Jensen M.B., The level of social contact affects social behaviour in pre-weaned dairy calves, Appl. Ani. Behav. Sci., 2011, 135(1-2), 34–43
21. Fericean, M.L., Radu. P., Olga, R. The behavior of calves, R.J.A.S., 2010, 42(2), 248
22. Rushen, J., D., Haleyand, A.M., de Passille, Effect of Softer Flooring in Tie Stalls on Resting Behavior and Leg Injuries of Lactating Cows, J. Dairy Sci., 2007, 90, 3647–3651
23. Weary, D.M., I., Taszkun, Hock lesions and free-stall design. J. Dairy Sci., 2000, 83, 697–702
24. Jensen, M.B., L.J., Pedersen, L., Munksgaard, The effect of reward duration on demand functions of rest in dairy heifers and lying requirements as measured by demand functions, Appl. Anim. Behav. Sci., 2005, 90, 207–217
25. De Wilt, J.G., Behaviour and welfare of veal calves in relation to husbandry systems. Dissertation. Agric. Univ. of Wageningen, The Netherlands, 1985
26. Acatincăi, S. Etologie. Comportamentul animalelor, Ed. Agroprint, Timisoara, 2013, pp. 202
27. Krysl, L., Hess, B.W., Influence of supplementation on behaviour of grazing cattle, J. of Anim. Sci., 1993, 71(9), 2546–55
28. Gaillard, C., Meagher, R.K., von Keyserlingk M.A.G., Weary, D.M., Social Housing Improves Dairy Calves' Performance in Two Cognitive Tests, PLoS ONE, 2014, 9(2)
29. Ellingsen, K.,Grahame, J.C., Vonne, L., Cecilie, M.M., Using qualitative behaviour assessment to explore the link between stockperson behaviour and dairy calf behavior, Appl. Anim. Behav. Sci., 2014, 153, 10–17
30 De Paula, V.A., A.M., de Passillé, D.M., Weary, Effects of the early social environment on behavioral responses of dairy calves to novel events, J. of Dairy Sci., 2012, 95(9), 5149-5155
31. Duve, L.R., D.M., Weary, U., Halekoh, M.B., Jensen, The effects of social contact and milk allowance on responses to handling, play, and social behavior in young dairy calves, J. of Dairy Sci., 2012, 95, 6571-6581
32. Held, S.D.E., M., Spinka, Animal play and animal welfare, Anim. Behav., 2011, 81, 891-899
33. Jensen, M.B., L.R., Duve, D.M., Weary, Pair housing and enhanced milk allowance increase play behavior and improve performance in dairy calves, J. of Dairy Sci., 2015, 98, 1-8
34. Krachun,K., Jeffrey, R., Anne Marie de Passille´, Play behaviour in dairy calves is reduced by weaning and by a low energy intake, Appl. Anim .Behav. Sci., 2010, 122, 71-76
35. Rushen, J., Anne Marie de Passillé, Automated measurement of acceleration can detect effects of age, dehorning and weaning on locomotor play of calves, Appl. Anim. Behav., 2012, 139(3-4), 169–174
36. Mintline, E.M., Wood, S.L., de Passillé, A.M., Rushen, J., Tucker, C.B., Assessing calf play behavior in an arena test, Anim. Behav. Sci., 2012, 141, 101-107