

Changes of Eating Behavior with Group Size and Social Rank Order in Steers

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Introduction

When the steers were rearing in group, to study the changes of eating behavior, which directly maintain the animal⁹⁾, with group size and social rank order was important. Only a few workers reported studies dealing with group size and social rank order was important. Only a few workers reported studies dealing with eating behavior, and a large number of workers reported the aggressive behavior, as affected by group size and social rank order. In these studies, the frequency and time of behavior were the points of focus. In a behavioral study, it is important to examine not only daily frequency and time, but also the behavioral sequence.

This study was conducted to study the changes of eating behavior with group size and social rank order. Eating time, eating frequency and meal length are compared for group size and social rank order. The eating behavior is examined in terms of precedent behavior and subsequent behavior, and is further divided into 7 types (behavioral transition). The occurrence ratio and meal length of each transition are compared for group size and social rank order.

Materials and Methods

Animals used were 12 Holstein steers of five months of age. These steers were assigned to one of three groups in which the means of live-weight were equal (4-steer group). Then, first and second rank steers in the 4-steer groups were reared together (2-steer group). Steers were reared in an experimental lot (29.5 × 3.6 m), and offered a mixed ration of pelleted concentrate (60%) and chopped hay (40%) twice daily, every morning (8:00) and evening (17:00) ad libitum. Experimental lots (Fig. 1) had two feeding troughs at the east end and one water

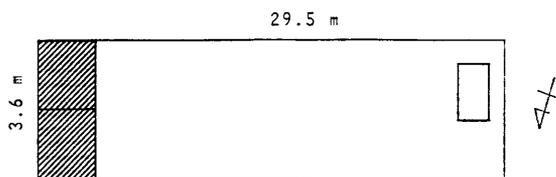


Fig. 1. Layout of the experimental lot.

▨ Feeding trough, □ Water trough.

tough at the west end. The experimental period was 10 days for each group.

The observation of behavior was conducted continuously on the last day (from 7:00 to 18:00) of each experimental period, and eight repertoires of behavior were adopted, as follows: eating (E), drinking (D), ruminating (R), lie down or stand up (LS), locomotion (L), social behavior (S), non-biological object (ex. trough, fence etc.) touching behavior (T), and body care (C). Aggressive behavior was recorded to determine the social rank order of steers.

The behavioral transition was written in the form of (precedent behavior, subsequent behavior). For example, the designation (E, L) was means that the steer ran away from the feeding trough after eating. The proportion of each behavioral transition to total transitions (the behavioral ratio) was calculated, and the difference of behavioral ratio for group size and social rank order was examined using Wilcoxon-Mann-Whitney two-sample test⁶⁾.

Results

Table 1 shows the average of eating time, eating frequency and meal length in 4- and 2-steer groups. The eating time of the 4-steer group was similar to that of the 2-steer group. Eating frequency was greater in the 4-steer group than in the 2-steer group. The meal length was shorter in the 4-steer group than in the 2-steer group.

Eating time, eating frequency and meal length in each social rank order are shown in table 2. Eating time of the second and third rank steers was significantly ($P < 0.05$) longer than that of the fourth rank steer. Eating frequency of scond

Table 1. Mean of eating time, eating frequency and meal length of steers in different group size

		Group size	
		2-steer	4-steer
Eating time	min./day	100.7	94.0
Eating frequency	times/day	14.2 ^a	21.8 ^b
Meal length	min./times	7.1 ^a	4.3 ^b

Mean with different superscripts differ significantly ($P < 0.05$).

Table 2. Mean of eating time, eating frequency and meal length of different social rank steers in each group

		Group size					
		2-steer		4-steer			
Social rank order		1	2	1	2	3	4
Eatingtime	min./day	102	99	92	99	98	87
Eating frequency	times/day	14	14	29 ^a	17 ^b	30 ^a	11 ^b
Meal length	min./times	7	7	3 ^a	6 ^{a b}	3 ^a	8 ^b

Mean with different superscripts differ significantly ($P < 0.05$) within same group size.

and fourth rank steers was significantly ($P < 0.05$) greater than that of first and third rank steers. Meal length was significantly ($P < 0.05$) longer for the fourth rank steer than for the first and third rank steers. These differences did not show up in 2-steer group.

Table 3 shows the precedent and subsequent behavioral ratio to eating in 4- and 2-steer group. The behavioral ratio of (T, E), (E, T), (L, E) and (E, L) in 2-steer group was significantly ($P < 0.05$) higher, but the ratio of (S, E) and (E, S) was significantly ($P < 0.05$) lower than that in 4-steer group. The ratio behavioral of (C, E) was significantly ($P < 0.05$) higher in the 2-steer group than that in the 4-steer group.

Table 4 and 5 show the precedent and subsequent behavioral ratio to eating

Table 3. The behavioral ratio of each transition of steers in different group size

	Precedent behavior		Subsequent behavior	
	2-steer	4-steer	2-steer	4-steer
	%			
D	0.0	0.0	0.0	0.0
R	0.0	0.0	0.0	0.0
L S	0.0	0.0	7.4	4.3
L	34.6 ^a	13.5 ^b	19.5 ^a	3.2 ^b
S	11.3 ^a	68.1 ^b	18.9 ^a	54.2 ^b
T	30.7 ^a	13.3 ^b	42.3 ^a	23.1 ^b
C	23.4 ^b	5.1 ^a	11.9	15.2

Mean with different superscripts differ significantly ($P < 0.05$) between 2- and 4-steer group. D: Drinking, R: Ruminating, LS: Lie down or stand up, L: Locomotion, S: Social behavior, T: Non-biological object touching behavior, C: Body care.

Table 4. The precedent behavioral ratio of each transition of steers in different social rank order

Social rank order	Group size					
	2-steer		4-steer			
	1	2	1	2	3	4
(Transition)	%					
(D, E) ¹⁾	0.0	0.0	0.0	0.0	0.0	0.0
(R, E)	0.0	0.0	0.0	0.0	0.0	0.0
(L S, E)	0.0	0.0	0.0	0.0	0.0	0.0
(L, E)	35.9	33.3	13.1	10.3	11.1	19.5
(S, E)	12.2	10.4	74.9 ^a	73.2 ^a	67.7 ^a	56.6 ^b
(T, E)	28.2	33.2	10.0	11.1	15.3	16.8
(C, E)	23.7	23.1	2.0	5.4	5.9	7.1

Mean with different superscripts differ significantly ($P < 0.05$) within same group size. See footnote in table 3 about behavioral character.

1) (precedent behavior, eating).

in each social rank order. The behavioral ratio was the same for first and second rank order in the 2-steer group. The behavioral ratio of (S, E) in the 4-steer group was significantly ($P < 0.05$) lower for fourth rank steer than for the other steers. The behavioral ratio of (E, S) was significantly ($P < 0.05$) higher for first rank steer than for other steers. The behavioral ratio of (E, G) and (E, S) was lowest in first rank steer and that of (E, G) was highest in fourth steer.

Table 6, 7 and 8 show the meal length for each behavioral transition. Regardless of group size, meal length of (S, E) and (E, S) behavioral transition was shorter than that of any other transition. In the 4-steer group, the meal length of every (precedent behavior, E) transition in first and third rank steers was shorter than that in second and fourth rank order. In the 2-steer group, this did not differ with social rank order. In the 4-steer group, the meal length of every (E,

Table 5. The subsequent behavioral ratio of each transition of steers in different social rank order

Social rank order (Transition)	Group size					
	2-steer		4-steer			
	1	2	1	2	3	4
	%					
(E, D) ¹⁾	0.0	0.0	0.0	0.0	0.0	0.0
(E, R)	0.0	0.0	0.0	0.0	0.0	0.0
(E, L S)	7.6	7.2	3.2	4.8	5.6	3.6
(E, L)	20.3	18.7	3.2	3.8	0.0	5.8
(E, S)	19.2	18.6	80.8 ^a	50.3 ^b	47.2 ^b	38.5 ^b
(E, T)	40.6	44.0	8.3 ^a	17.2 ^{a b}	30.5 ^b	36.4 ^b
(E, C)	12.3	11.5	4.5 ^a	23.9 ^b	16.7 ^b	15.7 ^b

Mean with different superscripts differ significantly ($P < 0.05$) within same group size. See footnote in table 3 about behavioral character.

1) (eating, subsequent behavior).

Table 6. The mean of meal length in each behavioral transition of steers in different group size

	Precedent behavior		Subsequent behavior	
	2-steer	4-steer	2-steer	4-steer
	min			
D	—	—	—	—
R	—	—	—	—
L S	—	—	9.5	8.2
L	7.7	8.2	7.8	9.9
S	4.4	3.9	5.5	4.1
T	7.0	6.0	7.4	5.2
C	7.6	8.8	6.4	7.0

See footnote in table 3 about behavioral character.

Table 7. The mean of meal length for precedent behavioral transition of steers in different social rank order

Social rank order	Group size					
	2-steer		4-steer			
	1	2	1	2	3	4
(Transition)	min.					
(D, E) ¹⁾	—	—	—	—	—	—
(R, E)	—	—	—	—	—	—
(L S, E)	—	—	—	—	—	—
(L, E)	7.5	7.9	5.5	10.4	6.5	10.3
(S, E)	5.8	3.0	2.7	4.5	2.3	6.2
(T, E)	6.8	7.1	3.6	8.0	4.1	8.3
(C, E)	7.6	7.5	4.0	15.0	5.8	10.5

See footnote in table 3 about behavioral character.

1) (precedent behavior, eating).

Table 8. The mean of meal length of subsequent behavioral transition of steers in different social rank order

Social rank order	Group size					
	2-steer		4-steer			
	1	2	1	2	3	4
(Transition)	min.					
(E, D) ¹⁾	—	—	—	—	—	—
(E, R)	—	—	—	—	—	—
(E, L S)	9.3	9.7	6.7	9.0	6.0	11.0
(E, L)	7.2	8.4	7.3	7.5	—	15.0
(E, S)	5.6	5.3	2.3	5.0	2.4	6.2
(E, T)	7.6	7.2	3.9	6.7	3.5	6.5
(E, C)	6.8	6.0	5.0	6.7	4.1	12.2

See footnote in table 3 about behavioral character.

1) (eating, subsequent behavior).

subsequent behavior) transition was shorter in the first and third rank steers than that in second and fourth rank steers. Again, in the 2-steer group, this did not differ with social rank order.

Discussion

There was no effect of group size on eating time, but it did affect eating frequency and meal length. These results relate to the number of feeding troughs in the experimental lot. In the present study, the experimental lot had only two feeding troughs regardless of group size, and in the 4-steer group, only two steers were able to eat at one time. In the 4-steer group, the behavioral ratio of (S, E) and (E, S) was higher than in the 2-steer group. This suggests that in the 4-steer

group, the competition for trough access during eating was greater than that in the 2-steer group. The meal length of each behavioral transition was shorter in (S, E) and (E, S) than that of any other transition regardless of group size. It is concluded that daily eating time was not affected by group size, but eating frequency and meal length were changed by group size due to the competition for feeding trough access.

In the 2-steer group, eating time, eating frequency and meal length did not differ with social rank order, but in the 4-steer group, there difference occurred. Eating time and eating frequency of fourth rank steer were lowest in 4-steer group, but meal length of the fourth steer was longest in the group. Beilharz¹⁾ found that significant positive association existed between dominance value and eating time. Fried et al.³⁾ pointed out that social position would be important when the feeding space was severely restricted. In present study, steers were restricted the use of feeding trough, because of insufficient of trough in the 4-steer group, and the eating time of fourth rank steer was lowest in the 4-steer group. But in the 2-steer group, steers were not restricted the use of trough, and did not differ for social rank order. These results were in agreement with opinions of Friend et al. and Beilharz. In the 4-steer group, as previously described, the competition for access to the feeding trough occurred more than in the 2-steers group. The fourth rank steers were almost excluded from the feeding trough while the higher rank steers ate, eating mainly when the other steers were not near the feeding trough. It is presumed that this is why their eating frequency was less and meal length was longer than that of the higher rank steers. In fourth rank steer, the behavioral transition of (S, E) was significantly ($P < 0.05$) lower than in other steers. It was evidence that eating after aggression to others was less in fourth rank steer than in other steers.

The first rank steer in the 4-steer group did not have the longest eating time, and meal lengths of each transition. The behavioral ratio of (E, S) in the first rank steer was significantly ($P < 0.05$) higher than that of other steers, and (E, T) in the first rank steer was lower than that of other steers. The meal length of each transition for first rank steer were shortest in the 4-steer group. It is suggested that the first rank steer is more aggressive than other steers, and when he is eating, he often stops eating to attack to other steers. McPhee et al.⁵⁾ found that high-ranking order animals had a priority at the feeding trough. However, Friend and Polan²⁾ commented that dominance value were not adequate indicators of priority at the feeding trough. In present study, it was concluded that while the first rank steer has priority at the feeding trough, he disclaim his priority because of his activity.

In 4-steer group, the meal lengths for each behavioral transition of third rank steer, in the same manner of first rank steer, was shorter than that of second and fourth rank steers. This is suggests that eating behavior did not changed according to social rank order. It was already described that the first order steer was more aggressive than other steers. It is presumed that the third order steer was attacked by higher order steer, mainly first rank steer, and was excluded from

the feeding trough, but unlike the fourth steer, the third steer would not eat if the higher rank steers were not eating. Thus, it is supported that the behavioral ratio of (S, E) in the third rank steer was similar to that of the first and second steers.

It is concluded that eating behavior changed with group size related to the number of feeding troughs, and that if steers were greater in number than the feeding troughs, eating behavior differed with social rank order. It was also suggested that the changes of eating behavior due to social rank order dependent on the social position.

Summary

To study the changes of eating behavior with group size and social rank order, and to examine the relationship between eating behavior and behavioral transition, the following experiment was conducted using 12 Holstein steers. Group size were 4 steers and 2 steers. The steers were fed mixed ration of pelleted concentrate (60%) and chopped 2nd cut hay (40%) ad libitum. The experimental lots (29.5 × 3.6 m) had 2 feeding troughs. The results are summarized as followed. 1) Group size was not affected in eating time, but affected in eating frequency and meal length. 2) Eating time, eating frequency and meal length was not different with social rank order in the 2-steer group, but in the 4-steer group, there were different with social rank order. 3) Group size was affected in the behavioral ratio. In the 4-steer group, proportion of eating after or before the social behavior was increased and other behavioral ratio was decreased. 4) In the 4-steer group, the difference of behavioral ratio between social rank order was recognized in transition of the social behavior, body care and non-biological object touching behavior. 5) The meal length of the transition about the social behavior was shortest regardless of group size and social rank order. 6) In the precedent and subsequent behavioral transition to eating, meal length was shorter in the first and third rank steer, than that in the second and fourth rank steer. 7) The changes with the social rank order of eating behavior in the 4-steer group was related to the competition with steers for feeding trough because of insufficiency of trough to steers.

References

- 1) Beilharz, R. G., 1979. Competitive order as a measure of social dominance in dairy cattle: a criticism of the paper by Friend and Polan. *Appl. Anim. Ethol.*, 5: 191-192.
- 2) Friend, T. H. and C. E. Polan, 1978. Competitive order as a measure of social dominance in dairy cattle. *Appl. Anim. Ethol.*, 4: 61-70.
- 3) Friend, T. H., C. E. Polan and M. L. McGilliard, 1977. Free stall and feed bunk requirements relative to behavior, production and individual intake in dairy cows. *J. Dairy Sci.*, 60: 108-116.
- 4) Hatton, G. I., 1975. Ingestive mechanisms and behaviours. In *The Behaviour of Domestic Animals*. (E. S. E. Hafez ed.), 73-107, Bailliere Tindall, London.
- 5) McPhee, C. P., G. McBride and J. W. James, 1964. Social behaviour of domestic animals. III. Steers in small yards. *Anim. Prod.*, 6: 9-15.
- 6) Steel, R. G. D. and J. H. Torrie, 1980. Nonparametric statistics. In *Principles and Proce-*

dures of Statistics; A Biometrical Approach. 533-553, McGraw-Hill Book Company, New York.

要 約

去勢牛における群飼養頭数および優劣順位による採食行動の変化を、前後の行動型に注目して検討した。供試牛にはホルスタイン種去勢牛 12 頭を用い、群飼養頭数により 4 頭区および 2 頭区を設けた。飼料は、ペレット状配合飼料 (60%) と細切 2 番刈り乾草 (40%) を混合し、自由採食させた。試験ロット (29.5×3.6 m) には、2 台の飼槽を設置した。得られた結果は、以下の通りである。1) 採食時間に群飼養頭数の影響は認められなかったが、4 頭区の採食期回数は 2 頭区に比べ有意 ($P < 0.05$) に多く、採食期の長さは有意 ($P < 0.05$) に短かった。2) 2 頭区における採食時間、採食期回数および採食期の長さに優劣順位による差は認められなかった。これに対し 4 頭区では、優劣順位によりこれらの値は変化した。3) 4 頭区において採食の前後に他の牛に対する行動の起こる行動推移割合は、2 頭区に比べ高く、その他の行動推移割合は低かった。4) 行動推移割合における優劣順位の影響は、4 頭区での他の牛に対する行動、物に対する行動および自身に対する行動に関する推移で認められた。5) 他の牛に対する行動に関する推移における採食期の長さは、他の推移における採食期の長さに比べ最も短かった。6) 4 頭区における第 1, 3 位牛の各行動推移における採食期の長さは、いずれの推移においても、第 2, 4 位牛のそれに比べ短かった。7) 4 頭区における優劣順位による採食行動の変化は、飼槽不足による競合と関連するものと考えた。