

Distribution of Eating Bouts and Inter-bout Intervals in Steers Offered Mixed Ration *ad libitum*

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(May, 1991)

Key words: eating bout, inter-bout interval, steers, distribution,
ad libitum feeding, log survivor functions

Introduction

Feed intake is directly related to animal production. It is important to study the feed intake of animals and the details of their eating behavior. The distribution of eating bouts and inter-bout intervals has already been examined in birds and rats. Levitsky²⁾ suggested that because these distributions were significantly different from random distribution that the probability of the starting and stopping of eating in rats was not constant. Slater⁴⁾ noted similar results in birds. Forbes et al.¹⁾ studied the distribution of inter-bout intervals in cows offered silage *ad libitum*. They found that the distribution of intervals changed at eight minutes of interval length. In these studies, the distribution of eating bouts and inter-bout intervals was only used to determine a criterion for meal length. Morita et al.³⁾ stated that the distribution of eating bouts changed at four minutes of bout length, regardless of the feeding order or the kind of ration. In our previous report³⁾, we did not study the distribution of inter-bout intervals, and steers were not offered rations *ad libitum*, but for 160 minutes a day.

The present study was carried out in order to obtain information on the distribution of eating bouts and inter-bout intervals in steers offered ration *ad libitum*. The probability of strating and continuing was also calculated.

Materials and Methods

Three Holstein steers were reared together in three different size of lots (8.8 m², 35.5 m² and 70.8 m² per steer), staying 1 week in each area. During the last 4 days of each week, the starting and stopping times of eating were recorded continuously (96 hours). The starting and stopping of eating were the entering of the steer's head into the trough and the swallowing the bait, respectively. However, eating was not considered to have stopped when eating succeeded the swallowing. Eating bouts and inter-bout intervals were calculated from the recorded data.

The steers were offered a mixed ration of pelleted concentrate (70%) and chopped hay (30%) *ad libitum* twice daily, every morning (8:30) and evening (16:30). The ration offered was greater than 110% of the amount of eating. The chem-

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Table 1. Chemical composition of diet

	DM	CP	NDF	ADF
	%	% of DM basis		
Concentrate	87.2	19.2	14.7	6.9
Hay	86.2	12.0	48.7	29.2

1) Dry Matter, 2) Crude Protein, 3) Neutral Detergent Fiber, 4) Acid Detergent Fiber

ical composition of the concentrate and hay is shown in Table 1.

The log survivor function was the method by which the distribution of behavioral length was studied whether the distribution fitted to the exponential (random) distribution or not. If the distribution of bouts and intervals fitted to the exponential distribution, the log survivor function would be a straight line. It appeared that the probability of starting and continuing eating would be constant in a random distribution of eating bouts and inter-bout intervals. If the distribution of bouts and intervals did not fit the exponential distribution, the bouts and intervals would be separated by the length of bout and interval (eating bout and inter-bout interval criterion) into a subgroup of which the distribution fits the exponential distribution. First, the distributions of eating bouts and inter-bout interval lengths were plotted in the form of a log survivor function (Fig. 1). Then the linearities of regression of these log survivor functions were examined using the test for linearity.

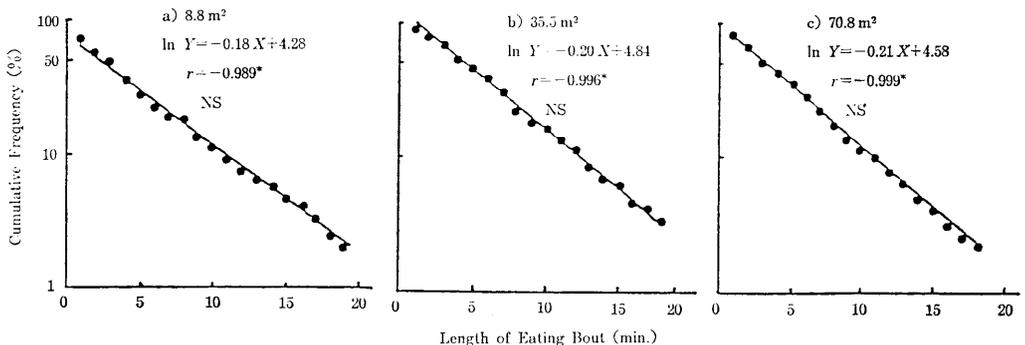


Fig. 1. Log survivor functions for eating bout lengths of steers offered mixed ration *ad libitum* in different size of lot. Each point gives the percentage of eating bout longer than the eating bout length on the abscissa. NS indicates that the distribution of eating bouts did not differ from random distribution.

Results and Discussion

Table 2 shows the daily time spent eating and the frequency of eating bouts. The daily time spent eating was approximately 145 minutes. There were approximately 30 eating bouts daily.

Table 3 shows the daily time spent non-eating and the frequency of inter-bout intervals. The daily time spent non-eating was approximately 1250 minutes, and

Table 2. Daily time spent eating and frequency of eating bout

	8.8 m ²	35.5 m ²	70.8 m ²
Time spent eating (min./day)	140	154	148
Frequency of eating bout (times/day)	33	26	30

Table 3. Daily time spent non-eating and frequency of inter-bout interval

	8.8 m ²	35.5 m ²	70.8 m ²
Time spent non-eating (min./day)	1255	1211	1245
Frequency of inter-bout interval (times/day)	32	25	29

the frequency of inter-bout intervals was approximately 30 times per day.

The log survivor functions of eating bouts for steers reared in the different areas are shown in Fig. 1. In all cases, these log survivor functions were not significantly different from straight lines. Because of these results, the probability of continuing of eating was constant, regardless of eating bout lengths in each rearing area. In our previous study³⁰, it was shown that the log survivor function of eating bout lengths for steers offered rations for 160 minutes a day was significantly different from a straight line. We also chosen an eating bout criterion of four minutes, regardless of the kind of ration. In the present study, the steers were offered mixed rations *ad libitum*, and an eating bout criterion did not exist in the distribution of eating bouts. It is suggested that the existence of an eating bout criterion is affected, not by the kind of diet or rearing area, but by the daily access time to feed.

The log survivor functions of inter-bout intervals for steers reared in the different areas are shown in Fig. 2. Because the log survivor functions of interval lengths were not different from straight lines, the probability of starting of eating was constant, regardless of the inter-bout interval lengths in each area. Forbes et al.¹⁰ found that the slope of the log survivor function changed at eight minutes of interbout interval length for 12 cows allowed to eat silage *ad libitum*. The present study was similar to Forbes' with regard to access time to feed, but differed in the kind of diet. It is suggested that the existence of an inter-bout interval criterion is affected, not by rearing area, but by the kind of diet.

Table 4 shows the probabilities of the starting and continuing of eating. The probability of starting of eating was approximately 2% and that of continuing of eating ranged from 78% to 85%.

From these results, it is concluded that the distribution of eating bouts and inter-bout intervals is random, and that the probability of starting and continuing is constant when steers are offered a mixed ration of concentrate and hay *ad libitum*. It is suggested that the existence of criteria for eating bouts and inter-bout intervals is not affected by rearing area, but that the existence of an eating bout criterion is affected by daily eating time and inter-bout interval by the nature of the diet.

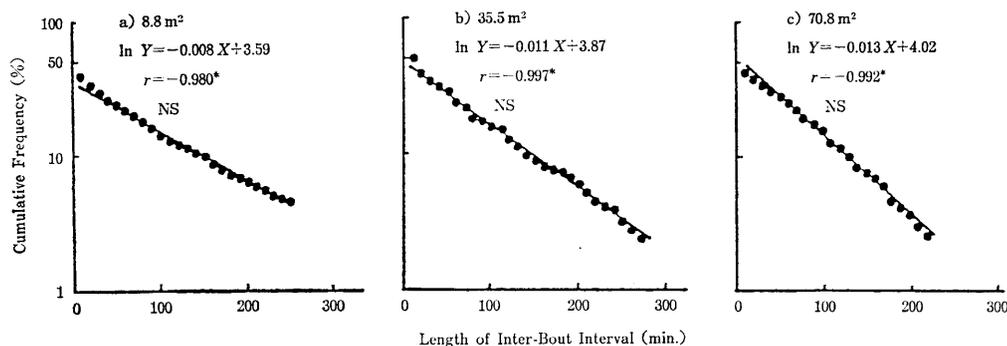


Fig. 2. Log survivor functions for inter-bout interval lengths of steers offered mixed ration *ad libitum* in different size of lot. Each point gives the percentage of inter-bout intervals longer than the inter-bout interval on the abscissa. NS indicates that the distribution of inter-bout intervals did not differ from random distribution.

Table 4. Probability of starting and continuing of eating of steers offered mixed ration *ad libitum*

	8.8 m ²	35.5 m ²	70.8 m ²
Probability		%	
Starting	2.4	2.0	2.2
Continuing	78.2	84.5	81.8

Summary

The distribution of eating bouts and inter-bout intervals in steers offered a mixed ration *ad libitum* was studied. The probability of starting and continuing of eating was calculated at *ad libitum* feeding.

Three steers were reared together in three different size of lots. The Steers were offered a mixed ration of pelleted concentrate (70%) and chopped hay (30%) *ad libitum*. The results are summarized as follows.

The daily time spent eating and frequency of eating bout ranged from 140 to 155 minutes and from 26 to 33 times per day, respectively. The daily time spent non-eating and the frequency of inter-bout intervals ranged from 1211 to 1255 minutes and from 25 to 32 times per day, respectively. The log survivor functions of eating bouts and inter-bout intervals were not significantly different from straight lines. It appeared that their distribution was random, and the probability of starting and continuing of eating would be constant. The probability of starting was approximately 2%, and that of continuing ranged from 78% to 85%.

Reference

- 1) Forbes, J. M., D. A. Jackson, C. L. Johnson, P. Stockill and B. S. Hoyle, 1986. A method for the automatic monitoring of food intake and feeding behaviour of individual cattle kept in group. *Research and Development in Agriculture*, 3: 175-180.

- 2) Levitsky, D. D., 1970. Feeding pattern of rats in response to fasts and changes in environmental conditions. *Physiol. Behav.*, 5: 291-300.
- 3) Morita, S., M. Hirano and S. Nishino, 1991. Effects of arrangement of feeding order of diets on probability of eating bout continuing and frequency of eating bout in steers. *Jpn. J. Livest. Management*, 26: 75-81.
- 4) Slater, P. J. B., 1974. The temporal pattern of feeding in the Zebra Finch. *Anim. Behav.*, 22: 506-515.

要 約

本試験では、去勢牛に乾草と配合飼料を混合した飼料を自由採食させた場合の採食行動について、採食を開始し終了するまでの継続時間（採食継続時間）および採食を終了してから次の採食開始までの継続時間（休止継続時間）の分布を検討した。さらに、それぞれの継続時間分布から採食を継続する確率、ならびに採食を開始する確率を求めた。

3頭の去勢牛を群飼し、1頭あたりの飼養面積の異なる3種類のロット（8.8 m², 35.5 m² および 70.8 m²）に放し飼いした。飼料は、配合飼料と乾草が原物比で7:3となるように混合し、自由採食させた。得られた結果は以下の通りである。

各面積における1日あたりの採食時間、採食期回数は、それぞれ140~155分/日、26~33回/日の範囲にあった。また、1日あたりの採食休止時間および休止期回数は、それぞれ1211~1255分/日および25~32回/日の範囲にあった。採食継続時間および休止継続時間と対数化した累積頻度との関係は、いずれの面積においても直線となり、両継続時間の分布はランダムであった。各飼養面積における採食を開始する確率は、休止継続時間の長さによらず2.0~2.4%の範囲にあった。また、採食を継続する確率は、78.2~84.5%の範囲にあった。このことから、乾草と配合飼料を混合し自由採食させた場合の、去勢牛の採食を継続する確率および開始する確率は、継続時間の長さに関わらず一定であると判断した。