

Feeding frequencies and their effect on behavior of nursing sows

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Abstract An experiment to relate behavior activities with reference to feeding was carried on 16 lactating sows and their litters after one week of farrowing. Two types of diets were fed to the sows. The control group (C) animals were fed with standard ration containing 18% crude protein (CP). The ration for kitchen waste fed group (K) was prepared by substituting the CP of standard ration by food leftover kitchen wastes to the extent of 40%. The sows were randomly distributed into four groups based on frequency of feeding either once (C₁, K₁) or twice (C₂, K₂). All the sows were housed individually. The behavior data of sows were collected on ethogram data sheet using scan sampling method. Instantaneous sampling time recording rule was followed to record the listed activities at regular interval during the study period. The sows activities were recorded for 15 days after one week of farrowing. The activities were recorded for 4 hours split between morning and evening, one hour before and one hour after offering of feeds to the sows (8:30 to 9:30 am, 10:30 to 11:30 am, 3:00 to 4:00 pm and 4:30 to 5:30 pm). Nine behavioral parameters were recorded and categorized into 3 major attributes viz., feeding and nursing behavior, active self-care behavior and inactive resting behavior. The sows weaned their litters at the end of 8 weeks. The data on litter size at birth and at weaning was used to compare the nursing behavior with productivity of sows. The increased frequency of feeding made sows spend significantly more time ($P < 0.01$) in eating while reducing their inactive resting time. Thus reduced frequency of feeding to once per day is more beneficial in terms of keeping pigs undisturbed and also this reduces the labour requirement for feeding purpose.

Keywords: behavior, ethogram, sows, kitchen wastes, sows

Introduction

Feeding and management are the major activities that require more labour time in manual feeding facilities. Further when the pigs are fed more than once a day require labourer to spend more time in feeding activity. Several researchers have studied the feeding frequencies 3-9 times per day (Hessel et al 2006) and concluded that thrice feeding pigs provided better welfare than 9 times feeding daily.

Pigs in conventional indoor fattening pig production are normally fed 2-3 times daily whereby the feed is consumed within 15 min after offering of feed (Persson et al 2008). Some researchers have reported that feeding more occasions from 2 to 6 times daily have increased the body weight and performance of pigs (Schneider et al 2011). While Persson et al (2008) have reported that there is no benefit of either weight gain or well being by increased frequency of feeding from 3 to 9 times a day. Further Zoric et al (2015) observed that the water content and the nature of feeds offered influences the behavior performance of pigs and that feeding dry feeds has better pig performance compared to liquid feed leftovers from food industry.

Feeding frequency is thought to be an important enrichment for pigs especially the sows which are nursing their piglets. It is very essential to know the behavior of lactating sows when they are fed with different types of ration and in different time intervals. Lactating sows have dual role of self care and nursing of piglets. Ethogram of commonly seen activities helps us understand the common needs of lactating sows with respect to their mothering ability. Very few studies are reported to note the behavior of gestating sows. Pigs have wisdom of taking right quantity of feeds and water when they are offered liquid based feed (Prasanna et al, 2011). It is important to know the behavior pattern to apply this knowledge of their time distribution in various activities such as suckling time given to emphasize their mothering ability. Their feed consuming time to

evaluate their hungry status when feed was offered as well as standing and sleeping time to know their energy reserve status or time spent on exercise etc. An ethogram is an inventory of the behavior which gives description of all movements, positions, postures, interactions with other animals and interactions with the environment that is typical of any individual of a species. This study explores the performance of lactating sows by observing the repertoire of behavior through ethogram with reference to their mothering ability and the litter size they retained from birth to weaning.

Materials and Methods

The experiment was conducted to study the behavior of lactating sows at Swine Production unit of Indian Veterinary Research Institute (IVRI), Izatnagar, Bareilly-243122. The study consisted of 16 lactating sows which have farrowed 6-8 piglets. The sows were grouped into two groups based on type of feed offered viz, control group (C) and kitchen waste fed group (K). Based on frequency of feeding the groups were further classified as either once fed (C₁, K₁) or twice fed per day groups (C₂, K₂) with four sows in each group. The control group animals were fed standard ration with 18% crude protein (CP). The ration for kitchen waste fed group was prepared by substituting the CP of standard ration by kitchen wastes to the extent of 40%. The kitchen wastes were procured from students hostels every morning and had average of 80% moisture. The pigs were offered ad libitum water in the manger. During each of feeding period, feed was offered according to their requirements of body weight at the rate of 3%. Full feed was offered at 10 am for sows fed once while half the quantity was fed at 10 am for groups fed twice and other half at 4 pm.

The behavior parameters were classified into nine different activities based on observations recorded by Hessel et al. (2006). viz., eating, drinking water, lying in the covered area, lying in open area, sleeping, standing, sitting, wallowing and milk suckling.

For better understanding the ethogram of activities are defined as follows:

1. Feeding: ingestion of concentrates in control group, kitchen wastes mixed with concentrate ration in kitchen wastes group.
2. Drinking: voluntary oral ingestion of water from the manger at the time of observation.
3. Lying (covered area): lying with eyes open and resting mostly being idle maintaining a recumbent position.
4. Lying outside (open area): sow lying out in the open area and maintaining a recumbent position with eyes open.
5. Sleeping: lying inside with eyes being closed.
6. Standing: standing idly or walking or playing etc.
7. Sitting: sitting with fore limbs stretched out and hind limb on floor with dog sitting like posture.

8. Wallowing: indicating cooling body when they sat in water filled wallowing tanks present in the covered area.
9. Nursing: milk suckling of young ones born to the sows during lactation

The behavior activities of sows were collected on ethogram data sheet using scan sampling method, where all the individual animals of each group was quickly scanned in their respective pens. The behavior activities were recorded on an ethogram data check sheet using Instantaneous sampling time recording rule (Martin and Bateson 2007) to record the listed activities at regular interval of one minute in the total time frame of one hour study periods.

Each lactating sow with her suckling piglets were housed in individual farrowing pens in the same building with eight farrowing pens located on either sides of each row. The farrowing pens had dimension of 3.5 m × 3 m covered area provided with guard rails and 3.5 m × 3 m space of open area behind the covered area. There was a small gate to allow sows to move between covered and open areas. Most of the activities were recorded when the animals were present inside the covered area of shed. When the sows went outside the covered area for lying out the observation was recorded as lying outside. Milk suckling was recorded when the piglets were suckled either inside covered area or in the open area. To study the behavior of lactating sows, the observations were carried out for an hour before and after feeding during morning and evening in each group for 15 consecutive days after one week of parturition. The observations were made for four hours daily in following sequence:

1. One hour before offering feed in the morning feeding hour i.e., between 8:30 to 9:30 am (MB).
2. One hour following offering feed in morning i.e. between 10:30 to 11:30 am (MA).
3. One hour before offering feed in the evening feeding hour i.e. between 3:00 to 4:00 pm (EB).
4. One hour following offering feed in evening i.e. between 4:30 to 5:30 pm (EA).

All the listed behavior activities were recorded for all sows for four groups on an ethogram data check sheet with minute by minute activity shown by any of four sows of one group. Randomized block design was used with 2 × 2 factorial design (2 diets and 2 frequencies) for statistical analysis. Appropriate statistical techniques were used to analyze the data following Snedecor & Cochran (1994). Statistical package SPSS (Version 11.01, 15, Nov. 2001) and Microsoft Excel was used to perform the multivariate analysis of variance (MANOVA). General linear model was used to know the relation between effect of feeding frequencies on behavioral characteristics of selected animals. Duncan's multiple range test was used for identifying

differences among means in the required cases, when the analysis of variance was significant ($P < 0.05$ or 0.01).

Results and Discussion

The environment temperature during study period of April-June 2005 as obtained from Meteorological station of Division of Physiology and Climatology, IVRI varied between 23.92-44.36 °C. The results of behavioral studies (Min/hour, Least Square Mean ± Standard Errors) of sows have been presented in three tables based on the related activities. Table 1 indicates feeding and nursing related behavioral activities of sows (min/ hour). Table 2 indicates the comparison of litter performance of with reference to number of piglets in the litter that survived till weaning). Table 3 indicates inactive and resting behavioral activities of sows (min/hour). Table 4 indicates active and self-care behavioral activities of sows (min/hour). Table 5 indicates overall analysis of treatment × frequency interaction of behavioral activities of sows observed for four hours of the day (min/hour). The following notations have been used for the tables: MB- 8:30 to 9:30 am before feed offered (min/hour), MA - 10:30 to 11:30 am after feed was offered (min/hour), EB - 3:00 to 4:00 pm before feed was offered (min/hour), EA - 4:30 to 5:30 pm after feed was offered (min/hour), C₁ - control animals fed once a day, C₂ - control animals fed twice a day, K₁ - kitchen wastes offered once a day, K₂ - kitchen wastes offered twice a day.

Table 2 Comparison of litter performance of sows in the control (C₁, C₂) and kitchen wastes (K₁, K₂) fed groups (Number of piglets in the litter that survived till weaning).

| Groups | Little size at birth | Little size at weaning (56 days) |
|-------------------|----------------------|----------------------------------|
| C ₁ | 7.25±1.11 | 5.25±1.25 |
| C ₂ | 5.75±1.80 | 4.25±1.49 |
| K ₁ | 6.67±2.85 | 2.67±1.67 |
| K ₂ | 6.75±1.31 | 3.75±1.11 |
| Mean of once fed | 6.64±0.82 | 4.27±0.69 |
| Mean of twice fed | 6.83±0.85 | 4.83±0.69 |

No Significant differences were observed among mean±SE.
 C₁ - control animals fed once a day; C₂ - control animals fed twice a day;
 K₁ - kitchen wastes offered once a day; K₂ - kitchen wastes offered twice a day.

Feeding and nursing related behavioral activities of sows

Eating time

There were no significant differences among the groups in the time spent for eating. However maximum time was spent by all groups in the morning after feed was offered. There were considerable variations in the time spent between the groups with least feeding time in the morning

before offering feed. The eating time was higher in both once fed (18.30 min/hour) and twice fed (18.22 min/hour) control groups compared to kitchen wastes group fed once (13.75 min/hour) and fed twice (14.92 min/hour). This shows that eating concentrate feed requires more eating time due to higher dry matter content. The K group animals have consumed the feed faster due to higher moisture and palatability. Similar results was shown by Zoric et al (2015) whereby the total eating time observed in 12 hour study on weaned piglets was 8.26±2.7min in dry feeding system and 3.6 ± 1.3 min in liquid based wet feeding system. Debrecéni et al (2014) observed similar eating time of 16% which was second most activity after lying in pigs housed in hot climate conditions (30°C). Among the interacting groups eating duration was shown to be significantly ($P < 0.01$) higher in C₁ (19.57±0.57 min). This was probably due to higher quantities of feed being placed in morning and they had continued to eat even in the evening time also.

Drinking time

It was seen that drinking time was significantly higher ($P < 0.01$) in once fed control group (1.25 min/hour) and twice fed kitchen wastes group (1.20 min/hour) compared to kitchen wastes group fed once (0.38 min/hour) and control group fed twice (0.85 min/hour). It may be observed that higher duration of drinking time in C₁ group was due to higher dry matter content in concentrate feeds. Prasanna et al (2011) had observed that pigs fed with kitchen wastes has significantly ($P < 0.05$) lower water intake due to higher moisture content (80%). In similar experiment by Schneider et al (2011), reported that drinking time was between 0.31 to 0.33% and that there was no significant difference between groups when fed twice or six times a day.

Nursing of piglets time

It was observed that the mean nursing time spent by control group animals were similar either in once fed (4.90 min/hour) or in twice fed (4.19 min/hour). However the values were much lower in kitchen wastes fed group either in once fed (2.29 min/hour) or twice fed (2.33 min/hour). This indicates that the control group sows were able to suckle their piglets for more time and better care givers. Johnson et al (2001) observed that the average nursing time obtained by piglets was 20.30% in a day. This is an important activity that informs the amount of nursing time devoted on piglets which helps in survivability and optimum growth of litter.

On observation of the litter performance, it can be observed that there were no significant differences between litter size at birth and weaning indicating the nursing behavior was optimum in both the groups. However the litter size was seen decreasing in kitchen wastes offered group

Table 1 Feeding and nursing behavioral activities of sows (min/hour).

| Groups | Eating time | | | | Drinking time | | | | Nursing of piglets time | | | |
|--------------------|------------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|-------------------------|----------------|----------------|----------------|
| | Once fed | | Twice fed | | Once fed | | Twice fed | | Once fed | | Twice fed | |
| | C ₁ | K ₁ | C ₂ | K ₂ | C ₁ | K ₁ | C ₂ | K ₂ | C ₁ | K ₁ | C ₂ | K ₂ |
| MB | 3.33 ± 1.87 | 4.61 ± 1.40 | 9.84 ± 2.88 | 3.20 ± 0.87 | 0.62 ± 0.40 | 1.07 ± 0.27 | 0.31 ± 0.31 | 0.38 ± 0.19 | 4.93 ± 1.80 | 1.33 ± 0.98 | 4.35 ± 1.78 | 1.73 ± 0.84 |
| MA | 37.17 ± 7.00 | 26.52 ± 4.09 | 33.35 ± 7.68 | 22.59 ± 1.90 | 1.10 ± 0.66 | 0.15 ± 0.15 | 0.92 ± 0.51 | 2.19 ± 1.74 | 1.77 ± 1.49 | 0.00 ± 0.88 | 0.88 ± 0.88 | 0.00 ± 0.00 |
| EB | 19.57 ^A ± 0.57 | 10.86 ^B ± 2.61 | 10.85 ^B ± 0.61 | 16.26 ^{AB} ± 2.03 | 2.22 ± 0.58 | 0.00 ± 0.00 | 1.67 ± 0.56 | 0.48 ± 0.29 | 3.68 ± 0.74 | 3.75 ± 2.04 | 6.71 ± 2.03 | 5.79 ± 0.70 |
| EA | 12.63 ± 2.25 | 13.07 ± 3.21 | 18.60 ± 5.78 | 18.68 ± 3.26 | 0.94 ± 0.31 | 0.30 ± 0.17 | 0.42 ± 0.04 | 1.81 ± 0.30 | 9.16 ± 3.46 | 3.09 ± 1.94 | 4.64 ± 3.60 | 2.02 ± 1.03 |
| Pooled Mean values | 18.30 ± 3.62 | 13.75 ± 2.73 | 18.22 ± 3.55 | 14.92 ± 2.38 | 1.25 ^{AB} ± 0.27 | 0.38 ^B ± 0.14 | 0.85 ^B ± 0.24 | 1.20 ^{AB} ± 0.14 | 4.90 ± 1.18 | 2.29 ± 0.78 | 4.19 ± 1.16 | 2.33 ± 0.78 |

a,b-Means with dissimilar superscripts in a row differ significantly for particular activity (P≤0.05); MB- Morning time between 8:30 to 9:30 am before offering feed; MA- Morning time between 10:30 to 11:30 am after offering feed; EB-Evening time between 3:00 to 4:00 pm before offering feed; EA- Evening time between 4:30 to 5:30 pm after offering feed; C₁ - control animals fed once a day; C₂ - control animals fed twice a day; K₁ - kitchen wastes offered once a day; K₂ - kitchen wastes offered twice a day.

Table 3 Active self-care behavioral activities of sows (min/hour).

| Groups | Standing time | | | | Sitting time | | | | Wallowing time | | | |
|--------------------|----------------|----------------|-----------------|-----------------|-------------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|
| | Once Fed | | Twice Fed | | Once Fed | | Twice Fed | | Once Fed | | Twice Fed | |
| | C ₁ | K ₁ | C ₂ | K ₂ | C ₁ | K ₁ | C ₂ | K ₂ | C ₁ | K ₁ | C ₂ | K ₂ |
| MB | 7.25 ± 1.93 | 6.41 ± 3.03 | 4.32 ± 1.53 | 5.57 ± 1.31 | 1.83 ± 0.54 | 3.21 ± 1.30 | 3.62 ± 3.53 | 0.30 ± 0.22 | 6.66 ± 0.94 | 4.21 ± 0.88 | 3.16 ± 1.63 | 5.44 ± 0.81 |
| MA | 2.07 ± 1.28 | 6.87 ± 2.65 | 5.37 ± 2.65 | 5.47 ± 0.29 | 0.00 ± 0.00 | 0.00 ± 0.00 | 0.00 ± 0.00 | 0.67 ± 0.67 | 3.38 ± 1.25 | 0.50 ± 1.56 | 2.94 ± 1.56 | 1.94 ± 1.47 |
| EB | 7.76 ± 3.14 | 8.48 ± 3.77 | 14.84 ± 1.73 | 15.14 ± 0.21 | 4.60 ± 2.36 | 1.31 ± 0.84 | 2.06 ± 1.28 | 1.20 ± 0.80 | 10.37 ± 5.18 | 1.64 ± 1.30 | 3.20 ± 1.60 | 6.73 ± 5.59 |
| EA | 6.05 ± 2.07 | 4.12 ± 2.30 | 12.37 ± 4.08 | 6.69 ± 0.29 | 2.38 ^{abc} ± 1.15 | 0.62 ^{bc} ± 0.31 | 0.27 ^c ± 0.27 | 3.43 ^{ab} ± 0.62 | 8.09 ± 3.74 | 2.33 ± 0.88 | 4.80 ± 1.53 | 5.47 ± 1.48 |
| Pooled Mean values | 5.80 ± 1.14 | 6.43 ± 1.27 | 9.33 ± 1.77 | 8.02 ± 1.27 | 2.28 ± 0.73 | 1.30 ± 0.50 | 1.50 ± 0.92 | 1.39 ± 0.50 | 7.17 ^A ± 1.61 | 2.17 ^B ± 0.56 | 3.53 ^{AB} ± 0.71 | 4.56 ^{AB} ± 0.56 |

a,b,c - Means with dissimilar superscripts in a row differ significantly for particular activity (P≤0.05). A,B - Means with dissimilar superscripts in a row differ significantly for particular activity (P≤0.01). MB- Morning time between 8:30 to 9:30 am before offering feed; MA- Morning time between 10:30 to 11:30 am after offering feed; EB-Evening time between 3:00 to 4:00 pm before offering feed; EA- Evening time between 4:30 to 5:30 pm after offering feed; C₁ - control animals fed once a day; C₂ - control animals fed twice a day; K₁ - kitchen wastes offered once a day; K₂ - kitchen wastes offered twice a day.

Table 4 Inactive resting behavioral activities of sows (min/hour).

| Groups | Lying time under covered area | | | | Lying time under open area | | | | Sleeping time | | | |
|--------------------|-------------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------|------------------------------|-------------------------------|------------------------------|-----------------------------|-------------------------------|
| | Once fed | | Twice fed | | Once fed | | Twice fed | | Once fed | | Twice fed | |
| | C ₁ | K ₁ | C ₂ | K ₂ | C ₁ | K ₁ | C ₂ | K ₂ | C ₁ | K ₁ | C ₂ | K ₂ |
| MB | 12.86 ± 2.73 | 13.38 ± 2.80 | 7.18 ± 4.83 | 12.75 ± 1.45 | 1.10 ^B ± 1.11 | 1.55 ^B ± 1.17 | 11.88 ^A ± 4.25 | 2.41 ^B ± 1.39 | 21.41 ± 4.33 | 24.23 ± 2.49 | 15.25 ± 1.76 | 28.22 ± 1.14 |
| MA | 6.16 ± 6.16 | 8.67 ± 11.38 | 11.38 ± 11.38 | 21.44 ± 5.32 | 2.87 ± 2.87 | 3.03 ± 1.76 | 1.76 ± 1.76 | 0.29 ± 0.29 | 5.48 ± 2.18 | 14.26 ± 1.70 | 3.39 ± 1.70 | 5.42 ± 1.83 |
| EB | 3.33 ^b ± 1.49 | 3.88 ^b ± 1.14 | 1.99 ^b ± 1.99 | 1.47 ^b ± 1.47 | 3.46 ± 0.45 | 18.98 ± 4.81 | 12.94 ± 6.55 | 15.26 ± 5.63 | 3.53 ± 2.42 | 10.29 ± 7.25 | 4.41 ± 3.57 | 2.28 ± 1.41 |
| EA | 7.58 ± 2.10 | 10.76 ± 2.08 | 1.96 ± 1.28 | 7.73 ± 0.48 | 2.14 ± 0.97 | 10.92 ± 3.65 | 10.11 ± 5.32 | 7.40 ± 1.22 | 11.05 ± 2.59 | 14.80 ± 1.58 | 6.83 ± 2.02 | 6.77 ± 1.37 |
| Pooled Mean values | 7.52 ± 1.84 | 9.17 ± 1.57 | 5.63 ± 2.93 | 10.85 ± 1.57 | 2.42 ^b ± 0.76 | 8.62 ^a ± 2.50 | 9.30 ^a ± 2.44 | 6.05 ^{ab} ± 2.50 | 10.37 ^{ab} ± 2.24 | 15.89 ^a ± 2.35 | 7.47 ^b ± 1.74 | 10.68 ^{ab} ± 2.35 |

a,b-Means with dissimilar superscripts in a row differ significantly for particular activity (P ≤ 0.05). A,B-Means with dissimilar superscripts in a row differ significantly for particular activity (P ≤ 0.01). MB-Morning time between 8:30 to 9:30 am before offering feed; MA-Morning time between 10:30 to 11:30 am after offering feed; EB-Evening time between 3:00 to 4:00 pm before offering feed; EA- Evening time between 4:30 to 5:30 pm after offering feed; C₁ - control animals fed once a day; C₂ - control animals fed twice a day; K₁ - kitchen wastes offered once a day; K₂ - kitchen wastes offered twice a day.

Table 5 Overall analysis of treatment × frequency interaction of behavioral activities of sows observed in groups fed once or twice a day (min/hour).

| Interaction | Feeding and nursing | | | Standing | Active self-care | | | Inactive resting | | |
|---------------------------|------------------------------|----------------|-----------------------------|-----------------------------|-----------------------------|----------------|------------------------------|-----------------------------|------------------------------|--|
| | Eating | Drinking | Milk suckling | | Sitting | Wallowing | Lying | Lying outside | Sleeping | |
| Mean of once fed | 17.27 ± 1.97 | 1.34 ± 0.21 | 3.44 ± 0.59 | 6.67 ± 0.70 | 1.76 ± 0.38 | 4.31 ± 0.78 | 7.66 ± 0.97 | 5.28 ± 1.03 | 12.29 ± 1.39 | |
| Mean of twice fed | 17.76 ± 1.72 | 1.11 ± 0.20 | 3.78 ± 0.79 | 7.88 ± 0.76 | 2.01 ± 0.44 | 4.02 ± 0.56 | 7.96 ± 1.26 | 6.10 ± 1.11 | 9.39 ± 1.43 | |
| Means of times of day | | | | | | | | | | |
| Morning | 18.64 ± 2.43 | 1.13 ± 0.23 | 1.98 ^B ± 0.42 | 5.75 ^B ± 0.53 | 1.11 ^B ± 0.33 | 3.60 ± 0.47 | 10.33 ^A ± 1.35 | 2.42 ^A ± 0.63 | 15.04 ^A ± 1.54 | |
| Evening | 16.40 ± 0.93 | 1.29 ± 0.17 | 5.36 ^A ± 0.83 | 8.56 ^A ± 0.84 | 2.78 ^A ± 0.45 | 4.92 ± 0.83 | 5.40 ^B ± 0.63 | 8.56 ^B ± 1.19 | 6.75 ^B ± 0.90 | |
| Means of times of feeding | | | | | | | | | | |
| Before | 10.73 ^B ± 1.13 | 1.06 ± 0.16 | 4.16 ± 0.45 | 8.23 ± 0.79 | 2.56 ^a ± 0.48 | 4.89 ± 0.76 | 7.52 ± 0.93 | 6.91 ± 1.24 | 13.95 ^A ± 1.73 | |
| After | 24.32 ^A ± 1.78 | 1.35 ± 0.23 | 3.17 ± 0.88 | 6.08 ± 0.65 | 1.32 ^b ± 0.30 | 3.63 ± 0.57 | 8.20 ± 1.29 | 4.07 ± 0.80 | 7.84 ^B ± 0.79 | |
| Overall mean | 17.68 ± 1.30 | 1.21 ± 0.14 | 3.56 ± 0.49 | 7.16 ± 0.52 | 1.94 ± 0.29 | 4.28 ± 0.48 | 7.74 ± 0.79 | 5.40 ± 0.75 | 10.76 ± 1.00 | |

Note: a, b - Means with dissimilar superscripts in a column differ significantly (P ≤ 0.05). A, B - Means with dissimilar superscripts in a column differ significantly (P ≤ 0.01). MB-Morning time between 8:30 to 9:30 am before offering feed; MA-Morning time between 10:30 to 11:30 am after offering feed; EB-Evening time between 3:00 to 4:00 pm before offering feed; EA- Evening time between 4:30 to 5:30 pm after offering feed; C₁ - control animals fed once a day; C₂ - control animals fed twice a day; K₁ - kitchen wastes offered once a day; K₂ - kitchen wastes offered twice a day.

when compared to control group after 56 days of weaning. Though no significant it could be observed that the mean suckling period devoted by kitchen wastes fed sows was lesser when compared to control group sows.

Active self-care behavioral activities of sows (min/hour)

Standing time

There were no significant differences between groups when the standing times were observed. However the standing times were higher in sows of both the groups fed twice a day. Johnson et al (2001) have observed that the mean standing time was 9.1% and 27.9% in sows housed indoor and outdoor respectively. It is observed that due to need for more movement the sows fed twice spent more time in standing or walking or playing. Zoric et al (2015) had recorded more restlessness among pigs offered wet feeds compared to those on dry feeds.

Sitting time

Sows sitting is an indication of temporary resting phase. According to Hoshino et al (2008), the dog-sitting (sitting) behavior in sows is considered as one of the stereotypic vice. The mean sitting time was lesser in sows fed twice daily however the results are non-significant. The present sitting time average of 1.30 to 2.28 min/hour is similar to the findings of Hoshino et al (2008) who found that the means of total duration of sitting postures for 24 hour and average duration of sitting bouts in lactating sows was 80.7±3.44 min and 2.6±0.11 min, respectively.

Wallowing time

Wallowing is an important activity to cool the body and an important active self-care activity. Since the average environmental temperature during the study period was between 23.92-44.36 °C, there was clear inclination for the sows to cool themselves by sitting in the water filled mangers which acted as wallowing tanks. The sows in once fed group C₁ sat significantly (P<0.01) longer time (7.17±1.61 min/hour) as compared to once fed kitchen wastes group (2.17±0.56 min/hour). Johnson et al (2008) found that sows spent approximately 7% of time in wallowing tanks when the environment temperature was 32°C. The wallowing activity has important bearing as enrichment for improved performance of sows.

Inactive resting behavioral activities

Lying time

The lying time either inside or outside was second highest time compared to eating time spent during eating hours. There are certain differences between time spent lying inside and time spent outside. The sows on kitchen wastes diet spent more time indoor or covered area compared to those fed on control diet. After the feed was offered in the morning the sows spent more time under covered area may be due to environmental temperature to keep cool during hotter parts of the day. However there were different significant times of time spent by sows lying time in the open areas. Zoric (2015) observed that there was significantly higher lying time by sows fed on dry feed ranging from 12.4 to 28.6% as compared to sows fed on wet feeding.

Sleeping time

Zoric (2015) observed that there was significantly higher sleeping time by sows fed on wet or dry feed ranged from 26.9 to 66.8%. Sleeping is the second most time spent after eating among sows. Highest sleeping time of 15.89±2.35 min/hour was observed in kitchen wastes fed group while those on control diet with twice feeding time had lowest sleeping time of 7.47±1.74 min/hour. This was probably indicating more resting time available due to faster eating time and palatability of feed. Good sleeping time is necessary both for piglets and sows. Yan et al (2011) observed that piglets slept for 42% of time. However more sleeping indicates of lesser active time. Probably the lesser litter size in kitchen waste fed group could have provided more sleeping time for the mother sows.

Overall the following order of behavior activities was observed viz., eating 29%, lying 22%, sleeping 18%, standing 12%, wallowing 7%, milk suckling 6%, sitting 3%, drinking 2%. The data indicates that all the behavior parameters were similar in the groups fed once or twice a day. However during evening hours significantly (P<0.01) longer duration of milk suckling to piglets, standing and sitting times were observed probably due to more active daylight hours. Further inactive phases was more common during morning hours before offering feed with significantly (P<0.01) longer durations of lying and sleeping was seen among the sows. This indicates sows like to spend considerably large amount of time in sleeping among the inactive resting time.

Conclusions

It may be seen that sows spent time on various activities which are important from point of maximum productivity. The major activities of concern are lying, suckling (time devoted for litter rearing), and eating. In general there is no difference in behavior performance of sows fed once or twice. The study showed that wet based

kitchen wastes feed allows faster eating. However the type of diet shows that feeding kitchen wastes based diet had shown lesser time of suckling to piglets and reduced litter size at weaning time. Further reducing frequency of feeding to once per day is more beneficial in terms of keeping pigs undisturbed and this will also reduce the labour requirements towards feeding pigs.

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