The Journal of Animal & Plant Sciences, 20(3), 2010, Page: 175-179
ISSN: 1018-7081

EFFECT OF DIFFERENT FLOOR TYPES ON THE GROWTH PERFORMANCE AND SOME BEHAVIOURAL TRAITS OF HOLSTEIN FRIESIAN CALVES

M. Yanar, T. Z. Kartal, R. Aydin, R. Kocyigit and A. Diler*

Department of Animal Science, College of Agriculture, Atatürk ,*Department of Animal Production and Health, Hinis Vocational Training School, Atatürk University, 25600, Hinis, Erzurum, Turkey
Corresponding author e-mail: myanar@atauni.edu.tr

ABSTRACT

The objective of the study was to compare growth performance, feed efficiency ratio and some behavioural characteristics of Holstein Friesian calves kept on wooden slat, rubber mats or concrete pens. The study was carried out in the Research Farm of the College of Agriculture at Atatürk University, Erzurum, Turkey by using twenty five Holstein Friesian calves (14 males and 11 females) in 2008. All pens were bedded daily with long wheat straw. While weights at weaning were not significantly affected by the type of floor, average 4 months weight of the calves housed on the slatted floor pens (93.3±2.1 kg) was significantly ($P<0.05$) higher than that of animals on the pens with rubber mats (83.3±2.2 kg). Total weight gains of calves on the pens with wooden slats between birth and 4 months of age (56.4±2.4 kg) was significantly ($P<0.05$) greater than that of the young animals on the pens with rubber mats (48.6±2.6 kg). Average amount of dry matter of the feed consumed per kg weight gains between weaning and 4 months of age was also significantly ($P<0.05$) lower for calves in slatted floor pens than others. Additionally, percentage of time spent for lying and standing behaviours respectively were significantly ($P<0.05$) higher and lower for calves in slatted floor pens than others. It is concluded that pens with wooden slats have positive effect on growth performance and behavioural characteristics of Holstein Friesian calves.

Key Words: Holstein Friesian, calves, type of floor, growth performance, behavioural traits

INTRODUCTION

Since the early stage of a calf's life is a critical period of time, housing and environmental factors, including floor and bedding material are important. The appropriate use of floor and bedding material for dairy calves can provide comfort, decrease the risk of contracting disease, and reduce stress. Adequate rest is also essential for the welfare of young growing animals, and it was also reported a positive relationship between growth rate and amount of rest (Mogensen *et al*. 1997; Hanninen *et al*. 2005). Because of this fact, improved flooring in dairy cattle housing systems has received considerable attention in recent years (Telezhenko, 2007). Ideally, the floor of the individual calf pens has not to be too slippery or too hard (for lying). A slippery floor disturbs locomotion and may restrain from other behaviour of the animals and is therefore a significant issue in animal welfare (Stefanowska *et al*., 2002).

Dairy calves raised in the cattle farms are kept in individual or group pens furnished with feed and water-milk buckets. The floor of the pens is usually made from concrete and long wheat straw is also commonly used as bedding material (Thickett *et al.,* 2003). In recent years, wooden slats and rubber mats have also started to be used as flooring materials in Turkey. Manninen *et al*. (2002), Benz (2002), Tucker *et al*. (2003) and Vanegas *et al.* (2006) reported that mature dairy cattle had a clear preference for rubber mats in their stalls and the animals had better the health of legs and hooves that has crucial significance for longevity of the cows, for dairy performance and for production economy. However, there is no comparative study investigating the influence of these flooring materials on the growth performance and welfare of the early weaned dairy calves. Therefore, the present research was undertaken to investigate and to compare effects of the different flooring materials (concrete, rubber mats and wooden slats) on the growth performance, feed efficiency ratio and some behavioural traits Holstein Friesian calves.

MATERIALS AND METHODS

The research was carried out in the Research Farm of the Agricultural College at Atatürk University, Erzurum in 2008. Twenty five Holstein Friesian calves (14 male, 11 female) were randomly allocated into three treatment groups according to the sex. The age of the calves at the beginning of the trial was the same but the initial weights (birth weights) of the calves ranged from 25 to 41 kg; from 25 to 43 kg and from 31 to 42 kg for concrete, wooden slats and rubber mats groups respectively. The calves were housed individually either on concrete-floors or on rubber mats, or wooden slatted floor pens for 4 months of age. The rubber mats were

fixed on the floor and all the pens were bedded daily with (2 kg) of long wheat straw.

The newborn calves were allowed to suckle their dams and received colostrum first three days. The amount of milk given to the calves was kept constant at 8 % of their birth weight during the milk feeding period as suggested by Yanar *et al.* (1994). Feeding milk to the calves was accomplished by using calf nipple bottles. All calves were weaned at 7 weeks of age and two kinds of calf starters (starter I and II) and high quality dry hay were used throughout the trial. The amount of feed consumed daily was measured and recorded. Chemical composition of the dry hay used in the study was 87.6% dry matter, 7.3% crude protein, 3.5% ether extract, 8.6% crude ash, 28.9% crude cellulose. The starter I had 87.5% dry matter, 18.2% crude protein, 5.0% ether extract, 7.8% crude ash, 11.8% crude cellulose. Starter II contained 88.3% dry matter, 17.1% crude protein, 4.2% ether extract, 10.2% crude ash, 11.8% crude cellulose. The animals were fed individually starters and dry hay *ad lib*. during the trial. Weights and body measurements were also determined at birth, weaning, 4 month of age. Weights were obtained by using a scale available in the calf building before the milk or dry feeds were served to the calves in the morning.

Behavioural activities of the calves were investigated by using instantaneous sampling method as described by Martin and Bateson (1993). In this method, calf's behaviour was recorded once a week by walking through the calf barn, at a distance from the pen at least 2.1 m, every 15 min from 9.00 until 12.00 h. The behaviour was recorded for each of the following activities by a slight modification of the methods of Panivivat *et al*. (2004) in which 1: lying (calf's body contacted bedding and ground), 2: standing (calf was inactive in upright position), 3: eating (calf's head was in feed bucket). Percentage time spent in each activity was calculated weekly.

Bedding score was rated on a scale of 1 to 5 as follows: 1: dry and clean, 2: 20% to 40% surface dirty or wet, 3: 40% to 60% of surface dirty or wet, 4: 60% or %80 surface dirty or wet as reported by Panivivat *et al*. (2004).

The data were analyzed statistically by using a 2x3 completely randomized factorial experimental design. Since the interactions between types of floor and sex of calf were not significant in the preliminary statistical analysis, they were excluded form the statistical model. Weights at birth and weaning were also included in the statistical model as a covariate for analysis of weaning, 4 months weights respectively. Behavioural data as well as bedding scores were also subjected to analysis of variance, since it was found out that the data had normal statistical distribution. The ANOVA analysis and Duncan's multiple comparison test were carried out by using SPSS (2004) statistics program.

RESULTS AND DISCUSSION

Least square means with standard error for weights obtained at birth, weaning and 4 months of age are presented in Table 1. While effects of the types of floor and sex of calves on the weaning weight were not significant, sex of calves had significant ($P<0.01$) influence on the birth weight. On the other hand, 4 month weight was significantly ($P<0.01$) affected by the types of floor and sex of calves. Average 4 month weight of the calves kept on the wooden slat pens was greater ($P<0.05$) than that of young animals housed on the rubber mats pens (Table 1).

Total weight gains in the pre-weaning period were not significantly influenced by the types of floor and sex of calves (Table 2). However, types of floor and sex of calves affected significantly ($P<0.01$) on the weight gain between weaning and 4 months of age as well as between birth and 4 months of age. The Holstein Friesian calves housed on the wooden slat pens had greater total weight gain between weaning and 4 months of age and between birth and 4 months weight than those kept on the concrete and rubber mats pens.

Least square means with standard error for feed efficiency between birth and 4 months of age are presented in Table 3. The influence of the types of floor on the feed efficiency value obtained in a period between weaning and 4 months of age was significant ($P<0.05$), and amount of feed dry matter consumed per kg weight gain from birth to 4 months of age was the lowest for the calves kept on wooden slat pens.

In Table 4, least square means with standard error for gains in body measurements are given. Neither types of floor nor sex of calves had significant effect on the gains in body measurements from birth to 4 months of age.

Average bedding scores of calves in wooden slats group was significantly ($P<0.05$) smaller ($P<0.05$) than these of calves in concrete and rubber mats groups (Table 5). Sex of the calves also had significant ($P<0.01$) influence on the average bedding scores between weaning and 4 months of age, between birth and 4 months of age.

Least square means with standard error for behavioural traits are presented in Table 6. While the percentage of time spent for lying ($P<0.05$) and standing ($P<0.05$) behaviours were significantly affected by the types of floor and sex of the calves, percentage of time for eating was not significantly affected by the kinds of floor and sex of the calves. The young animals kept on the wooden slatted floor spent the highest ($P<0.05$) percentage of time for lying and the lowest ($P<0.05$) percentage of time for standing compared to the other calves housed in concrete and rubber mats pens.

Birth weights of the calves in different floor type groups was not statistically different since the calves used

were randomly assigned to these treatment groups (Table 1). On the other hand, average birth weight of the male Holstein Friesian calves was 5,8 kg heavier (P<0.01) than that of female calves, and the result was in accordance with findings of Ugur and Yanar (1998) and Metin *et al.* (2006). The effects of the types of the floor and sex of the calves on the weights obtained at weaning and 4 months of ages were also significant (P<0.05). Four month weight of calves in the wooden slat group was 12.0 % and 6.9 % greater than these of young animals in the rubber mats and concrete groups. Total weight gains in the pre-weaning period were not significantly influenced by the types of floor and sex of calves as reported by Hanninen *et al*. (2005). However, average total weight gain of the calves in wooden slats group between weaning and 4 months of the ages (P<0.05) as well as between birth and 4 months of age (P<0.01) were significantly greater than these of calves in the rubber mats and concrete floor pens (Table 2). The result is in accordance with findings of Saharia and Sarker (1989) who have reported that different flooring materials (pucca floor vs. brick floor) had significant influence on the daily weight gain between birth and 3 months of age.

Average amount of dry matter of the feed (3.24±0.06) consumed per kg weight gains between birth and 4 months of age was in agreement of the findings of Yanar *et al*. (2000) who reported similar feed efficiency value for Holstein Friesian calves. The calves kept on the pens with rubber mats also consumed the highest (P<0.05) amount of the dry matter of the feed per kg weight gains than these housed on wooden slat (0.45 kg) and concrete (0.33 kg) pens (Table 3).

Table 1. Least square means and standard error for weights obtained at different stages of the growth of Holstein Friesian calves

		Body Weights at		
		Birth (kg)	Weaning (kg)	4. Months of Age (kg)
	N	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$ [3]	$\overline{X} \pm S_{\bar{x}}$ [3]
Overall Mean	25	35,5±1,2	47,2±0,7	87,8±2,0
Types of Floor		NS	NS	*
Concrete	9	36,6±1,8	46,6±1,1	86,9±2,1[ab]
Wooden Slats	9	35,4±1,8	46,3±1,1	93,3±2,1[a]
Rubber Mats	7	34,4±1,9	48,7±1,2	83,3±2,2[b]
Sex of Calves		**	NS	**
Male	14	38,4±1,4	48,30±0,9	91,2±1,8
Female	11	32,6±1,6	46,07±1,1	84,4±2,1

*: P<0.05, **: P<0.01, NS: Nonsignificant, $\overline{X} \pm S_{\bar{x}}$: Least square mean ± standard error, [a, b]: Means within a column without a common superscript letter differ statistically (P<0.05), [3] The mean values are adjusted for covariates (birth weight or weaning weight).

Table 2. Least square means and standard error for weight gains in various periods of the growth of Brown Swiss calves

		Total Weight Gains Between		
		Birth and Weaning (kg)	Weaning and 4 Months of Age (kg)	Birth and 4 Months of Age (kg)
	N	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$
Overall Mean	25	11,3±0,7	40,5±1,2	51,8±1,4
Types of Floor		NS	**	*
Concrete	9	10,7±1,1	39,7±2,0[b]	50,4±2,4[ab]
Wooden Slats	9	10,3±1,1	46,0±2,1[a]	56,4±2,4[a]
Rubber Mats	7	12,8±1,2	35,7±2,2[b]	48,6±2,6[b]
Sex of Calves		NS	*	**
Male	14	12,4±0,9	44,1±1,8	56,6±2,1
Female	11	10,1±1,1	36,9±2,1	47,0±2,4

*: P<0.05, **: P<0.01, NS: Nonsignificant, $\overline{X} \pm S_{\bar{x}}$: Least square mean ± standard error, [a, b]: Means within a column without a common superscript letter differ statistically (P<0.05).

Table 3. Least square means and standard error for feed efficiency values determined various stages of the growth of Holstein Friesian calves

		Feed Efficiency[1] Between		
		Birth and Weaning (kg)	Weaning and 4 Months of Age (kg)	Birth and 4 Months of Age (kg)
	N	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$
Overall Mean	25	2,87±0,19	3,41±0,06	3,24±0,06
Types of Floor		NS	*	NS
Concrete	9	3,06±0,32	3,44±0,10[ab]	3,32±0,09
Wooden Slats	9	3,07±0,32	3,16±0,10a	3,11±0,09
Rubber Mats	7	2,48±0,34	3,61±0,10[b]	3,30±0,10
Sex of Calves		NS	NS	NS
Male	14	2,89±0,25	3,30±0,08	3,15±0,08
Female	11	2,86±0,28	3,51±0,09	3,33±0,08

*: P<0.05, NS: Non-significant, $\overline{X} \pm S_{\bar{x}}$: Least square mean ± standard error, [a, b]: Means within a column without a common superscript letter differ statistically (P<0.05),
[1]Feed efficiency: Consumed dry matter of feed (kg) / weight gain (kg).

Although gains in body measurements between birth and 4 months of age were not affected significantly by types of floor, the young animals housed on the slatted floor pens had provided the highest gains in body length, height at withers, chest depth and heart girth compared to other calves.

Bedding scores obtained in pre-weaning and post weaning periods revealed that types of floor had significant (P<0.05) influence on the cleanness of the bedding material (Table 5). Long wheat straw used for

bedding material on the pens with rubber mats and concrete floor became dirtier and wetter than that used on slatted floor pens. Similar result was also reported by Smits and Wierenga (1991) who indicated that calves kept on the rubber mats were dirtier than those on hardwood slats.

Table 4. Least square means and standard error for gains in body measurements between birth and 4 months of age

		Body Length (cm)	Height at Withers (cm)	Chest Depth (cm)	Heart Girth (cm)
	N	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$
Overall Mean	25	23,6±1,2	16,7±1,3	10,1±0,8	24,7±0,9
Types of Floor		NS	NS	NS	NS
Concrete	9	25,1±2,0	17,8±2,2	9,9±1,3	23,1±1,6
Wooden Slats	9	23,9±2,0	18,2±2,2	10,3±1,3	26,3±1,6
Rubber Mats	7	21,9±2,0	14,0±2,3	10,1±1,4	24,7±1,7
Sex of Calves		NS	NS	NS	NS
Male	14	23,0±1,6	15,7±1,7	10,5±1,1	25,9±1,3
Female	11	24,3±1,8	17,7±1,9	9,6±1,2	23,5±1,4

Table 5. Least squares means with standard error for bedding scores of Holstein Friesian calves kept on pens with different types of the floor

		Average Bedding Scores Between		
		Birth and Weaning	Weaning and 4 Months of Age	Birth and 4 Months of Age
	N	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$
Grand Mean	25	2,1±0,1	3,1±0,01	3,1±0,1
Types of Floor		*	*	*
Concrete	9	$2,4\pm0,2^{b}$	$3,1\pm0,1^{b}$	$3,2\pm0,1^{b}$
Wooden Slats	9	$1,7\pm0,2^{a}$	$2,9\pm0,1^{a}$	$2,9\pm0,1^{a}$
Rubber Mats	7	$2,2\pm0,2^{ab}$	$3,3\pm0,1^{b}$	$3,3\pm0,1^{b}$
Sex of Calves		NS	**	**
Male	14	2,1±0,2	3,3±0,1	3,3±0,1
Female	11	2,1±0,2	2,9±0,1	2,9±0,1

*: P<0.05, **: P<0.01, NS: Non-significant, $\overline{X} \pm S_{\bar{x}}$: Least square mean ± standard error, [a, b]: Means within a column without a common superscript letter differ statistically (P<0.05).

Percentage of time spent for lying and standing behaviours were significantly (P<0.05) affected by the types of floor (Table 6). Calves housed on the pens with rubber mats and concrete floor spent the lowest percentage of time for lying, but the highest percentage of time for standing behaviours than calves kept on the wooden slatted pens. The result could be attributed to the dirty and wet bedding material which might result in discomfort for the calves on the rubber mats pens. Similar result was reported for the adult animals by Fregonesi *et al* (2007) who stated that dairy cows showed a clear preference for a dry lying surface, and they spend much more time standing outside the stall when only wet bedding is available.

In conclusion, based upon growth, feed efficiency and behavioural parameters, it could be suggested that pens with wooden slats floor is more appropriate than pens with rubber mats and concrete floor for housing of Holstein Friesian calves.

Table 6. Least squares means with standard error for percentage of time spent on different activities of Holstein Friesian calves as affected by different types of the floor between birth and 4 months of age

		Lying (%)	Standing (%)	Eating (%)
	N	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$	$\overline{X} \pm S_{\bar{x}}$
Overall mean	25	0.36±0.02	0.35±0.01	0.22±0.01
Types of floor		*	*	NS
Concrete	9	0.32 ± 0.03^{b}	0.36 ± 0.02^{b}	0.26±0.03
Wooden Slats	9	0.42 ± 0.03^{a}	0.30 ± 0.02^{a}	0.20±0.03
Rubber Mats	7	0.34 ± 0.03^{b}	0.40 ± 0.02^{b}	0.20±0.03
Sex of Calves		NS	NS	NS
Male	14	0.33±0.02	0.39±0.02	0.22±0.02
Female	11	0.37±0.03	0.32±0.02	0.23±0.02

*: P<0.05, NS: Non-significant, $\overline{X} \pm S_{\bar{x}}$: Least square mean ± standard error, [a, b]: Means within a column without a common superscript letter differ statistically (P<0.05).

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