

## EFFECT OF FLOOR TYPES ON THE GROWTH PERFORMANCE AND SOME BEHAVIOURAL TRAITS OF BROWN SWISS CALVES

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**Summary.** The study was carried out to compare growth performance, feed efficiency ratio and some behavioural characteristics of Brown Swiss calves kept on rubber mats, wooden slat or concrete pens. All pens were bedded daily with long wheat straw. While weights at weaning and 4 months of age were not significantly influenced by the type of floor, average 6 months weight of the calves housed on the rubber mats pens was significantly ( $P<0.05$ ) lower than those in wooden slat and concrete groups. Total weight gains of calves in wooden slat and concrete pens between 4 and 6 months of ages were significantly ( $P<0.05$ ) greater than these of the young animals on the rubber mats pens. Average amount of dry matter of the feed ( $4.15\pm 0.06$ ) consumed per kg weight gains between birth and 6 months of age was not affected significantly by the types of floor and sex of calves. However, percentage of time spent for lying ( $P<0.05$ ) and standing ( $P<0.01$ ) behaviours were significantly affected by the type of floors.

**Keywords:** Brown Swiss, calves, type of floor, growth performance, behavioural traits.

## SKIRTINGO TIPO GRINDŲ ĮTAKA ŠVEICARŲ VEISLĖS VERŠELIŲ AUGIMUI IR ELGSENAI

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**Santrauka.** Atliktas tyrimas norint palyginti šveicarų veislės veršelių priesvorį, pašarų pasisavinimą ir elgseną, laikant ant guminio pakloto, medinio pagrindo ir betoninių grindų. Visi gardai kasdien buvo kreikiami kviečių šiaudais. Nustatyta, kad atjunkymo metu ir sulaukus 4 mėnesių, grindų tipas neturėjo statistiškai ženklios įtakos veršelių augimui. Tuo tarpu sulaukus 6 mėnesių, veršelių, laikomų ant guminio pakloto, svoris buvo statistiškai ženkliai mažesnis palyginti su veršeliais, laikytais ant medinio pagrindo ir betoninių grindų ( $p<0,05$ ). Ši tendencija pradėjo ryškėti tarp 4–6 mėnesių veršelių. Įstirta, kad pašaro sausosios medžiagos suvartojimas kilogramui veršelio gyvojo svorio priaugti nuo atvedimo ir iki 6 mėnesių ( $4,15\pm 0,06$ ), priklausomai nuo grindų tipo ar veršelio lyties, nebuvo statistiškai ženkliai reikšmingas. Tačiau veršeliai ant medinių ir betoninių grindų statistiškai ženkliai ilgiau gulėjo ( $p<0,05$ ), o ant guminių grindų – ilgiau stovėjo ( $p<0,01$ ). Tai rodo, kad guminis paklotas nėra labai tinkamas veršeliams auginti.

**Raktažodžiai:** grindų tipas, priesvoriai, elgsena, šveicarų veislės veršeliai.

**Introduction.** The early phase of the young animals' life is so crucial because the calves are too susceptible to the environmental and housing factors such as floor and bedding materials. The type of floor and/or bedding may not only have an influence on the incidence of leg lesions but also on other pathologies, mortality and hygiene. Therefore, the appropriate floor and bedding material for calves have to be provided in the barns of the calf. The appropriate floor and bedding materials should improve animals' welfare and decrease their stress. Mogensen et al. (1997) and Hanninen et al. (2005) also reported positive relations between the amount of rest and growth rate. Because of these findings, in recent years, improved flooring in dairy cattle housing systems has received considerable attention (Telezhenko, 2007). The Ideal floor of the individual calf pens must not be too slippery since the slippery floor disrupts locomotion and may suppress other behaviour of the animals. Therefore, type of the floor is a significant issue in animal welfare (Stefanowska et al. 2002).

Recently, dairy calves in the modern dairy cattle farms in Turkey are housed in individual or group pens with

feed and water-milk buckets. Generally, the floor of the pen is concrete and long wheat straw is also utilized as bedding material. Yet, in recent years, rubber mats and wooden slats have also begun to be used as flooring materials in some of the dairy farms. In literature, the impact of the various flooring materials on the dairy performance, welfare and health of the cows were investigated by several researchers (Manninen et al., 2002; Benz, 2002; Tucker et al., 2003; Vanegas et al., 2006, Telezhenko, 2007, Norring et al. 2010). General conclusion drawn from these researches is that dairy cows had a preference for rubber mats in their stalls, and the animals had lower incidence of claw lesions and clinical lameness that is of crucial importance for dairy performance, longevity of the cows and for production economy. However, there is lack of comparative study investigating the effect of these flooring materials on the growth performance and welfare of the early weaned Brown Swiss calves. Therefore, the present study was carried out to investigate the effects of the various flooring materials (concrete, wooden slats and rubber mats) on the behavioural characteristics, growth rate and feed efficiency traits of Brown Swiss calves.

**Materials and methods.** Brown Swiss calves from the cattle herd of research farm of the Agricultural College of Atatürk University, Erzurum, Turkey were utilized in this study. The calves, 15 males and 15 females, were housed individually either on concrete-floors or on rubber mats, or wooden slatted-floor pens for 6 months. The rubber mats were fixed on the concrete floor and all the pens were bedded daily with (2 kg) of long wheat straw.

The 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). All calves were weaned at 7 weeks of age. Two different calf starters (starter I and II) and high quality dry hay were used throughout the trial. Chemical composition of the starter I was 88.0% dry matter, 18% crude protein, 4.8% ether extract, 8.0% crude ash, 12% crude cellulose. Starter II contained 88.0% dry matter, 17% crude protein, 4.5% ether extract, 10.0% crude ash, 12% crude cellulose. Dry hay had 87.8% dry matter, 7.1% crude protein, 3.8% ether extract, 8.4% crude ash, 28.4% crude cellulose. The animals were fed individually starters and dry hay ad lib. during the trial. The weights and body measurements were also determined at birth, weaning, 4 and 6 month of age. The quantity of feed consumed daily was recorded.

Behavioural activities of the calves were observed by using instantaneous sampling method as described by Martin and Bateson (1993). Calf behaviour was recorded once weekly 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. 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 for each week.

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 described by Panivivat et al. (2004).

The data were analyzed statistically by using a 2x3 completely randomized factorial experimental design. Since the interactions between type of floor and sex of calf were not significant in the preliminary statistical analysis, they were excluded from the statistical model. Weights at birth, weaning and 4 months of ages were also included in the mathematical model as a covariate for analysis of weaning, 4 and 6 months weights respectively. Behavioural data as well as bedding scores were also subjected to analysis of variance, because they were found out that they 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.** The difference in birth weights of calves in different floor type groups was statistically insignificant since the calves used were randomly assigned to these treatments. On the other hand, average birth weight of the male calves was 4.0 kg heavier than that of female calves, and the result was in accordance with findings of Yanar et al. (1994). 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 not significant. However, average 6 month weight of the calves kept on the wooden slat and concrete pens were 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 and between weaning and 4 months of ages were not significantly influenced by the type of floor and sex of calves as reported by Szyndler and Kaczor (2003) and Hanninen et al. (2005). However, average total weight gain of the calves in rubber mats group between 4 and 6 months of the ages was significantly ( $P<0.05$ ) lower than these in the wooden slat and concrete groups (Table 2).

Table 1. Least square means and standard error for weights obtained at different ages of Brown Swiss calves

	N	Birth Weight (kg)	Weaning Weight (kg)	4. Months Weight (kg)	6. Months Weight (kg)
		$\bar{X} \pm S_x^-$	$\bar{X} \pm S_x^{-3}$	$\bar{X} \pm S_x^{-3}$	$\bar{X} \pm S_x^{-3}$
Overall mean	30	37.3±1.0	47.2±1.2	87.1±1.4	125.2±1.1
Types of floor		NS	NS	NS	*
Concrete	10	35.1±1.8	47.3±1.1	86.3±2.5	127.2±1.9 <sup>a</sup>
Wooden Slats	10	37.8±1.8	46.3±1.1	87.8±2.4	127.9±1.9 <sup>a</sup>
Rubber Mats	10	39.1±1.8	47.8±1.1	87.2±2.5	120.5±1.9 <sup>b</sup>
Sex of Calves		*	NS	NS	NS
Male	15	39.3±1.5	46.9±0.9	87.4±2.0	126.2±1.6
Female	15	35.3±1.5	47.4±0.9	86.5±2.0	124.2±1.6

\* :  $P<0.05$ , NS:Nonsignificant,  $\bar{X} \pm S_x^-$ : Least square mean  $\pm$  standard error,

<sup>a, b</sup>: Means within a column without a common superscript letter differ statistically ( $P<0.05$ ),

<sup>3</sup> The mean values are adjusted for covariates (birth weight, weaning weight, 4 months weight).

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

	N	Total Weight Gains		
		Birth to Weaning (kg)	Weaning to 4 Months of Age (kg)	4 to 6 Months of Age (kg)
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$
Overall mean	30	9.2±0.6	39.7±1.5	38.0±1.1
Types of floor		NS	NS	*
Concrete	10	9.1±1.0	37.4±2.8	39.3±2.0 <sup>a</sup>
Wooden Slats	10	9.0±0.9	40.5±2.7	40.8±1.9 <sup>a</sup>
Rubber Mats	10	9.6±1.0	41.3±2.7	33.9±1.9 <sup>b</sup>
Sex of Calves		NS	NS	NS
Male	15	8.5±0.9	41.1±2.2	39.4±1.6
Female	15	10.0±0.9	38.4±2.1	36.6±1.6

\* : P<0.05, NS: Nonsignificant,  $\bar{X} \pm S_x$  : Least square mean  $\pm$  standard error,

<sup>a, b</sup> : Means within a column without a common superscript letter differ statistically (P<0.05).

Average amount of dry matter of the feed (4.15±0.06) consumed per kg weight gains between birth and 6 months of age was in agreement of the findings of Ugur et al. (2004) who reported similar feed efficiency value for Brown Swiss calves weaned early. The calves kept on the pens with rubber mats also consumed higher amount of the dry matter of the feed per kg weight gains than these housed on wooden slat (0.36 kg) and concrete (0.33 kg) pens (Table 3).

Body length among the all body measurements of the calves in the wooden slat group was statistically (P<0.01) greater than other groups of the calves (Table 4). Calves in the rubber mats had generally lower body measurements than these kept on wooden slat and concrete groups, but the differences were not statistically significant.

Bedding scores obtained in pre-weaning period indicated that types of floor did not have significant effect on the cleanness of the bedding material (Table 5). On the other hand, the bedding scores obtained from older calves in a period between 4 and 6 months of ages and birth to 6 month of age were significantly (P<0.05) influenced by types of floor and sex of calves. As long as the Brown Swiss calves grew, long wheat straw used as bedding material for the calves on rubber mats group became dirtier and wetter (P<0.05) than that of young animals kept on wooden slatted 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 3. Least square means and standard error for feed efficiency ratio<sup>1</sup> of Brown Swiss calves between birth and 6 month of ages

	N	Feed Efficiency Ratio for		
		Concentrate	Dry Hay	Total Feed
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$
Overall mean	30	2.54±0.04	1.60±0.04	4.15±0.06
Types of floor		NS	NS	NS
Concrete	10	2.50±0.08	1.53±0.08	4.05±0.11
Wooden Slats	10	2.43±0.08	1.58±0.08	4.02±0.11
Rubber Mats	10	2.68±0.08	1.69±0.08	4.38±0.11
Sex of Calves		NS	NS	NS
Male	15	2.46±0.06	1.61±0.06	4.09±0.09
Female	15	2.61±0.06	1.59±0.06	4.21±0.09

<sup>1</sup>Feed efficiency ratio: Consumed dry matter of feed (kg) / weight gain (kg), NS:Nonsignificant,

$\bar{X} \pm S_x$  : Least square mean  $\pm$  standard error.

Table 4. Least square means and standard error for gains in the body measurements of Brown Swiss calves between birth and 6 month of ages

	N	Body Length (cm)	Height at Withers (cm)	Chest Depth (cm)	Heart Girth (cm)	Cannon Bone Girth (cm)
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$
Overall mean	30	34.2±1.1	23.1±1.0	13.7±0.5	38.8±0.9	3.0±0.2
Types of floor		**	NS	NS	NS	NS
Concrete	10	33.5±1.8 <sup>b</sup>	24.9±1.7	14.9±0.9	38.7±1.5	2.9±0.3
Wooden Slats	10	39.8±1.8 <sup>a</sup>	24.4±1.7	13.2±0.9	38.5±1.5	3.2±0.3
Rubber Mats	10	29.4±1.8 <sup>b</sup>	20.0±1.7	12.9±0.9	39.2±1.5	2.7±0.3
Sex of Calves		NS	NS	NS	NS	NS
Male	15	32.6±1.5	23.2±1.4	13.4±0.7	39.1±1.2	3.0±0.2
Female	15	35.9±1.5	23.0±1.4	13.9±0.7	38.4±1.2	3.0±0.2

\*\* : P<0.01, NS : Nonsignificant,  $\bar{X} \pm S_x$  : Least square mean ± standard error,

<sup>a, b</sup> : Means within a column without a common superscript letter differ statistically (P<0.05).

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

	N	Average Bedding Scores		
		Birth to Weaning	4 to 6 months of ages	Birth to 6 months of ages
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$
Overall mean	30	2.1±0.1	3.4±0.1	3.1±0.1
Types of floor		NS	*	*
Concrete	10	2.4±0.2	3.5±0.1 <sup>ab</sup>	3.2±0.1 <sup>ab</sup>
Wooden Slats	10	1.7±0.2	3.1±0.1 <sup>b</sup>	2.9±0.1 <sup>b</sup>
Rubber Mats	10	2.2±0.2	3.7±0.1 <sup>a</sup>	3.3±0.1 <sup>a</sup>
Sex of Calves		NS	**	**
Male	15	2.1±0.2	3.6±0.1	3.3±0.1
Female	15	2.1±0.2	3.1±0.1	2.9±0.1

\* : P<0.05, \*\* : P<0.01, NS: Nonsignificant,  $\bar{X} \pm S_x$  : Least square mean ± standard error,

<sup>a, b</sup> : Means within a column without a common superscript letter differ statistically (P<0.05).

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

	N	Standing (%)	Lying (%)	Eating (%)
		$\bar{X} \pm S_x$	$\bar{X} \pm S_x$	$\bar{X} \pm S_x$
Overall mean	30	0.36±0.01	0.25±0.01	0.30±0.01
Types of floor		**	*	NS
Concrete	10	0.31±0.01 <sup>b</sup>	0.30±0.02 <sup>a</sup>	0.30±0.02
Wooden Slats	10	0.37±0.01 <sup>ab</sup>	0.26±0.02 <sup>ab</sup>	0.29±0.02
Rubber Mats	10	0.41±0.01 <sup>a</sup>	0.19±0.02 <sup>b</sup>	0.32±0.02
Sex of Calves		NS	NS	NS
Male	15	0.36±0.01	0.25±0.02	0.31±0.01
Female	15	0.37±0.01	0.26±0.02	0.29±0.01

\* : P<0.05, \*\* : P<0.01, NS: Nonsignificant,  $\bar{X} \pm S_x$  : Least square mean ± standard error,

<sup>a, b</sup> : Means within a column without a common superscript letter differ statistically (P<0.05).

Percentage of time spent for lying ( $P<0.05$ ) and standing ( $P<0.01$ ) behaviours were significantly affected by the type of floors (Table 6). Calves housed on the rubber mats pens had lowest percentage of time spent for lying, but highest percentage of time for standing behaviour 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.

#### Conclusion.

In conclusion, based upon growth, feed efficiency and behavioural parameters, it could be suggested that wooden slats and concrete floors are preferable to rubber mats for individual dairy calves' pens for Brown Swiss calves.

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