

## Dairy Cattle Behaviour in Different Housing Systems

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### Abstract

Dairy cattle housing are designed in different ways. Generally, the tie-stall housing systems, free-stall housing systems and loose housing systems are used in dairy cattle. Loose barn and free-stall barn systems have spread in recent years. Nowadays, housing types and building designs are come into prominence as the main trend in shelters planning for improving the animal welfare. Animal behaviours and environmental factors affect the herd management and shelter design in dairy cows company widely. When the animals are free in the housing area, cows stress reduces and productivity and animal welfare rise. Dairy cattle spent more time standing in freestall housing system according to the loose barn. As the lying bout is extended in the total time budget of dairy cattle, milk production is increased. Along with each hour increase of resting time is predicted to increase by 1.7 kg in milk production (Allen et al., 2013). In this review, studies conducted on the behaviour of dairy cattle in different housing systems were summarized owing to coming into the forefront appropriate shelter design to animal behaviour in dairy cattle breeding.

**Keywords:** Behaviour, dairy cattle, design, housing systems

### Farklı Barınak Sistemlerinde Süt Sığırı Davranışları

#### Öz

Süt sığırı barınakları farklı şekillerde tasarlanmaktadır. Genellikle süt sığırcılığında bağlı duraklı, serbest duraklı ve serbest (açık) barınak sistemleri kullanılmaktadır. Son zamanlarda serbest ve serbest duraklı barınak sistemleri daha fazla yaygınlaşmıştır. Barınak planlanmasında günümüzde ana trend olarak, hayvan refahını artıracak sistem ve tasarımlar ön plana çıkmaktadır. Hayvan davranışları ve çevresel faktörler, süt sığırı işletmelerinde sürü yönetimi ve barınak tasarımını geniş ölçüde etkilemektedir. Hayvanlar yapı içerisinde daha özgür olduğu zaman, ineklerde stresi azalmakta ve verimlilik ve hayvan refahı artmaktadır. Süt sığırları, serbest duraklı barınak sistemlerinde serbest barınak sistemine göre ayakta durmaya daha fazla zaman harcarlar. Süt sığırlarının toplam zaman bütçesi içerisinde yatma süresi uzadıkça süt üretimi artmaktadır. Dinlenme zamanında her bir birimlik artma ile birlikte süt üretiminin 1.7 kg artacağı tahmin edilmektedir (Allen et al., 2013). Bu derlemede, süt sığırı yetiştiriciliğinde hayvan davranışlarına uygun barınak tasarımları ön plana çıktığı için farklı barınak sistemlerinde süt sığırlarının davranışı ile ilgili yürütülen çalışmalar özetlenmiştir.

**Anahtar Kelimeler:** Davranış, süt sığırı, tasarım, barınak sistemleri

#### Introduction

The dairy sector has an important place in a protection of country economy and public health. Nowadays, the level of consumption of animal products in the country is an indicator of the development of the country. In dairy cattle, the most important parameter indicating the productivity is annual milk production per animal. Mean milk production was 2.942 tons animals-1 in Turkey, 9.9 tons animals-1 in The USA and 6.6 tons animals-1 in European Countries (Anonymous 2012).

Though dairy cattle presence of Turkey was 24 % of the European Countries average, milk production was 10% of that. This situation shows that is low in the milk yield per cattle in Turkey. Among results major of this can show inappropriate environmental conditions, deficiency in nutrition and genetic structure (Uzal and Uğurlu, 2008). A purpose of making a shelter for animals, in the first place, protect them from adverse environmental conditions and provide a suitable habitat for obtaining high yields (Demir, 1990). The behaviour dairy cattle depend on the interaction between the cows and their physical environment (Krawczel and Grant, 2009).

To understand behaviour features of livestock ensures to increase the economic benefits in animal husbandry and to more easily guidable of animals. The importance of issues related to animal behaviour in the design of animal shelters closely correlates with the intensity of the production and length of stay in the shelter for animals. Today, intensive farming practices limits the optimal environmental demands of animals and therefore it is known that they show abnormal behaviour as a result of failure to adapt to the environment of the animals. High temperature and relative humidity, the lack of ventilation and lighting facilities, failure in feeding, the behaviour of animal of breeders, needs and preferences unknown them, incorrect selection of tools and machinery, the housed more animals per unit area makes difficult to adapt to the environment of the animals. When all this negative conditions added limiting the freedom of movement of animals, in the animals housed individually or in groups consists of psychological pressure and stress is increasing (Olgun and Çelik 1997).

Behaviour is considered as a good indicator of animal welfare (Overton et al., 2002). Behaviour is reaction coming out thanks to in an animal body muscles and changing position a portion of or the entire body. A move showing as stable without changing the position of the animals can also be behaviour (Ünal and Akçapınar, 1994). Animal behaviour, organism's is the reaction the whole body against a particular alert or way a reaction against them environment (İnal, 2006). Animal behaviour is an expression of an effort to comply with various internal and external environments, and It is a response to a stimulus (Cengiz, 2006). The total duration of lying per day can be used as a measure of cattle welfare (Haley et al., 2001). Modern dairy cattle lie for 12 h per day and become stressed if deprived of lying (Fisher et al. 2002; Jensen et al. 2004).

Although a conflict may emerge in high yielding cows between eating and lying, they are lying primarily. Decreased lying can reduce food intake and yield, as well (Munksgaard and Thomsen 2012). Daily time budget for lactating dairy cows is given in Table 1.

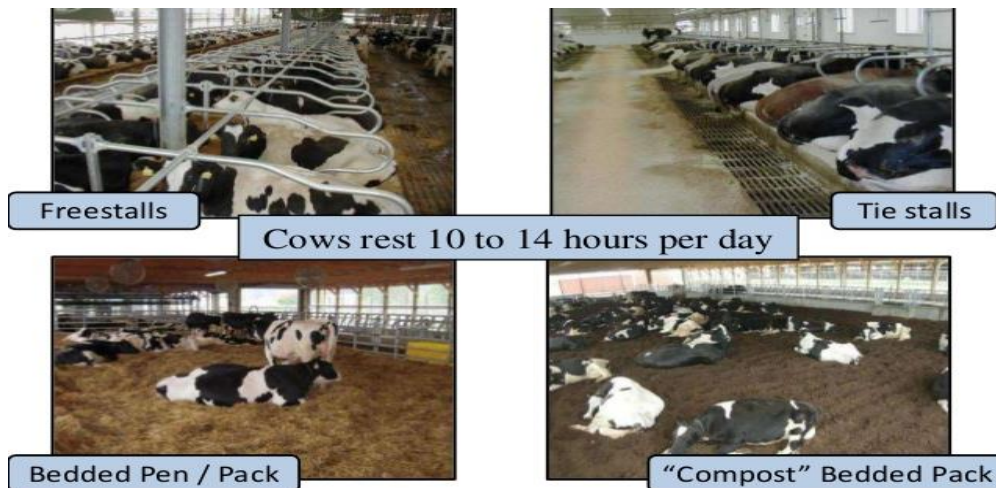
**Table 1.** Daily Time Budget for Lactating Dairy Cow (Grant, 2007)

Activity	Time devoted to activity per day
Eating	3 to 5 h
Lying/resting	12 to 14 h
Social interactions	2 to 3 h
Ruminating	7 to 10 h
Drinking	30 min
Management activities	2.5 to 3.5 h

## Behaviour of Dairy Cows Kept in Tie-Stall Barns

Keeping dairy cows in tie stalls are more traditional systems. This system is substantially limited to movement, grooming and social interaction is disrupted (Anderson, 2008), cows are unable to escape from dominant individuals (EFSA, 2009). And there is a raised risk of lameness and hock inflammation (Krohn and Munksgaard 1993).

Dairy cattle spend approximately 50 to 60% of their time lying down and are considerably motivated to maintain lying times of 12 to 13 h per day (Munksgaard et al., 2005). Cows housed in tie-stall barns spend more time increasingly depth of both sawdust and straw bedding increase (Tucker et al., 2009). Resting time per day of cows change in different barn systems (Figure 1).



**Figure 1.** Daily Resting Behaviour of Cows (McFarland, 2015)

Cows kept in tie-stall barn experience more difficulty in lying down. And they have a bigger incidence of collision with equipment and lower score of health status which reflects negatively on animal welfare. Moreover, it can also cause the decrease in productivity (Ostojic et al., 2011).

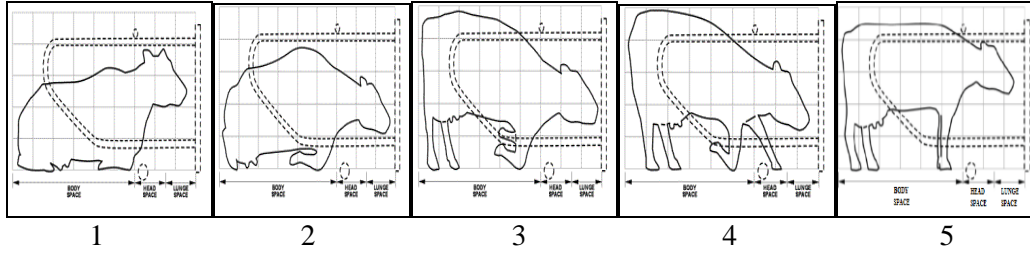
In tie-stall barns, cows are restricted to stalls where they are fed individually, and cows are either directly milked in the stall or walked to milking parlour (Reich, 2010).

Dairy cattle housed in tie-stall barns are more time spent idle standing and lying down. However, feed intake and time spent eating are unaffected by housing conditions (Haley et al., 2000).

In tie-stall barns, cows may forced to maintain movements necessary to lying down due to spatial restriction related to a very short tether (Haley et al., 2000). A very tether may limit the cows' ability to lunge forward (Haley et al., 2000).

As cows labour significantly on their front knees during changes in body position, the hardness of the concrete flooring may make standing and lying painfully for cows (Metzner, 1978).

Owing to tie-stall barns were light especially of workload, it was a system preferenced in the beginning. However, nowadays this system is not preferencing to animals' movements limits (Figure 2).



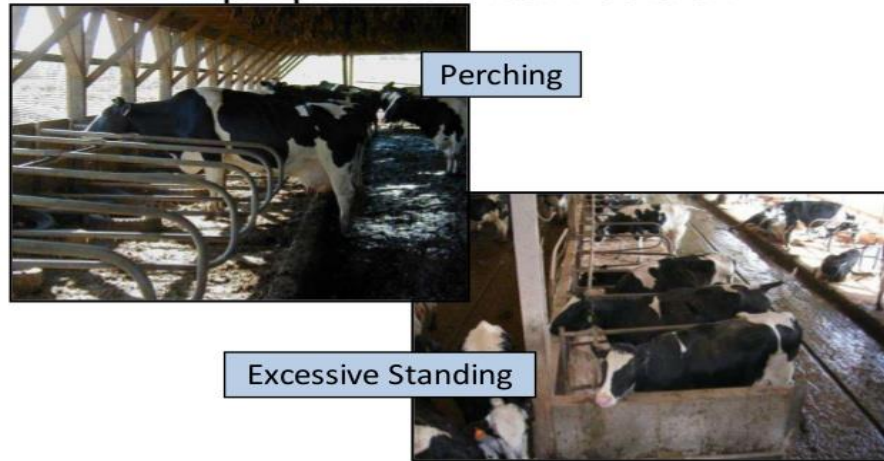
**Figure 2.** The Stages of a Cow's Stand Up Behaviour (Graves et al., 2009)

### Behaviour of Dairy Cows Kept in Free-Stall Barns

One of the most important design criteria for dairy cattle shelters is to access to a comfortable sleeping area (Ito et al., 2009). Stall design (Tucker et al., 2004; Tucker et al., 2006) and especially stall flooring (Tucker et al., 2003; Tucker and Weary, 2004) are most important factors affecting of time cows spend lying down.

Placement of neck rail affects stall usage (Reich, 2010). Neck rail arranged in very restrictive status decrease amount of time cows spend standing in the stalls (Tucker et al., 2005; Bernardi et al., 2009; Fregonesi et al., 2009) (Figure 3).

### Improper Neck Rail Position



**Figure 3.** Improper Neck Rail Position (McFarland, 2015)

Cows spend more time lying down in wider stalls (132 vs.112 cm; Tucker et al., 2004) and in stalls with no brisket boards (Tucker et al., 2006). Cows spend more time to lying down on surfaces that are more comfort and softer (Tucker and Weary, 2001). Dairy cattle prefer to lying down on soft bedding depending on the quality and quantity of bedding used (Herlin, 1997; Tucker et al., 2003; Benz, 2009). When cows are ensured an undesirable stall surface, raised standing outside of stalls occurs (Tucker et al., 2006; Fregonesi et al., 2007b). Cows occur a reduction five hours per day in time spent lying down on wet bedding (26.5% dry matter) by comparison with dry bedding (86.4% dry matter) (Fregonesi et al., 2007b). Daily time spent lying down increased from 8.8 h to 13.8 h when dry bedding was turned into wet bedding (Fregonesi et al., 2007b). While 54% of cattle on dry bedding were observed to lying down, this incidence decreased by 17-20% as bedding were dirty (Varlyakov, 1989). Cows spend lower time 1.1 h per day on wettest treatment compared to driest treatment (Reich, 2010) (Table 2).

**Table 2.** The Hours per Day (mean  $\pm$  SE) Cows Spent Performing Each Behaviour on Each Bedding Dry Matter Level, Averaged Across Seasons (Reich, 2010)

Behaviours (Mean $\pm$ SE)					
Bedding Dry Matter (%)	Lying in Stall (h/d)	Standing in Alley (h/d)	Perching in Stall (h/d)	Standing in Stall (h/d)	Feeding (h/d)
34.7	10.4 $\pm$ 0.4	6.2 $\pm$ 0.3	1.4 $\pm$ 0.1	0.2 $\pm$ 0.1	5.6 $\pm$ 0.1
43.9	10.9 $\pm$ 0.4	6.0 $\pm$ 0.3	1.4 $\pm$ 0.1	0.2 $\pm$ 0.1	5.3 $\pm$ 0.1
62.2	11.2 $\pm$ 0.4	5.3 $\pm$ 0.3	1.4 $\pm$ 0.1	0.3 $\pm$ 0.1	5.6 $\pm$ 0.1
74.2	11.0 $\pm$ 0.4	5.6 $\pm$ 0.3	1.6 $\pm$ 0.1	0.2 $\pm$ 0.1	5.4 $\pm$ 0.1
89.8	11.5 $\pm$ 0.4	5.4 $\pm$ 0.3	1.4 $\pm$ 0.1	0.2 $\pm$ 0.1	5.4 $\pm$ 0.1

When there are more cows than free-stalls, the behaviour may be affected because all of the cows can't synchronously lie down (Fregonesi et al., 2007b). Overstocking free-stall barns reduce time spent lying down (Friend et al., 1977; Wierenga and Hopster, 1990). When the stocking rate increased from 100 to 150%, time spent lying reduced by 1.7 h (Fregonesi et al., 2007a). When cows are overcrowding, aggressive interactions are more common as they contend to restricted resources (Fregonesi and Leaver, 2002). They spent more time standing outside of free-stalls when cattle were overstocked, and they spent less time lying down (Fregonesi et al., 2007a) (Table 3).

**Table 3.** Time Budget to Stocking Level in Freestall Barns

Variable	Stocking level for freestalls				
	%100	%109	%120	%133	%150
Lying in stall (h/d)	12.9	12.1	12.0	11.5	11.2
Front legs in stall (h/d)	1.4	1.4	1.4	1.4	1.5
Outside stall (h/d)	8.4	8.9	9.1	9.6	9.9
Latency to lie (min)	29	34	38	28	26
Displacements (n/5h) (n=4 groups)	0.7	0.9	1.6	2.1	1.9

Free-stall barns are considered important for allowing the adequate opportunity to dairy cattle in lying and resting area, for maximizing production as well as cow comfort and well-being (Haley et al., 2000). Some free-stalls barns are overcrowded with cattle in excess of the number of the stall. In addition, uncomfortable stalls can decrease the time that dairy cattle spend lying down either because of providing insufficient area to the cattle for resting or because floor of the free-stall is too hard (Leonard et al., 1994).

### Behaviour of Dairy Cows Kept in Loose Housing Systems

Loose dairy cattle shelters are barn system given the ability to move freely to cows. In dairy cattle are selected lighter, low-cost, open barns instead of completely closed, heavy and expensive barns. These shelters are also appropriate to natural behaviours of cows (Anonymous, 2015).

Loose housing systems provide the chance to move to dairy cattle and allow them to display their natural behaviour of the animals. In addition, a well-established social environment can have a positive effect on the adaptability to environment of individuals through social facilitation and learning, and stable social relations within the herd may be

useful in reducing the impact of the overall stressful conditions. (Bouissou et al., 2001). However, when the dairy cattle are housed in groups, there is a risk of aggression and social unrest. Aggressive interactions occur against establishing and maintaining social order within the group. Competition for resources as well as the source of improper shelter design is vitally important factors that can be reduced or increased the social stress and aggressive behaviour (Bouissou et al., 2001).

In loose housing system, the automation of business processes can decrease the manpower up to 40 hours annually per animal. Also, advantages of the loose housing system are easier supplying of enough micro-climate and zoo-hygiene circumstances (Ostojic, 2011).

In loose housing system was observed behaviour of twelve Holstein dairy cattle during three day and as a result of research, it was determined to spent by resting 45% and by feeding 25.9% of cattle daily times' (Antov and ark, 1991).

Resting behaviour is an important factor increased productivity in dairy cattle. Matzke (2003), examined the behaviour of cattle groups getting average and high milk yield. According to the survey results, the group of cattle with high milk yield of resting more 2-3 hours than the group of cattle average milk yield.

The flooring of shelters where dairy cattle lie down should be adequately comfortable to provide an adequate resting and welfare to animals. Recreation is defined as the situation lying down or standing doing nothing but ruminating. Before lying down, cows generally stand for a few minutes in the choice of places to rest. Preferences to lying side of cattle are not random. When cattle lying for the second time, more than 80% of them change lying side (Mitev et al., 2012).

Agonistic interaction can be more in indoor freestall systems than on pasture (Miller and Wood-Gush, 1991). This situation is probably due to area. Because, area limited prevents the escape of aggressive individuals. Behaviour of cattle in freestall housing systems having to inadequate space for lying and getting up is worse than on pasture (Schrer and Pelzer, 2006).

When tie stall barns compared with free systems, on the lying behaviour of both heifer and cows have certain effects (Krohn and Munksgaard, 1993; Jensen, 1999). Area discovery and attempts to lying before lying down of cattle housed in tie stall barns are restricted much more than loose housing barns of that. Because of the reasons mentioned above, nowadays loose housing systems instead of freestall barns and tie stall barns are recommended in terms of both compliance with behaviour of animal and construction cost.

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