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MONTHLY CHANGES OF BEHAVIORAL CHARACTERISTICS IN HOLSTEIN-FRIESIAN, BROWN SWISS AND SIMMENTAL BULLS

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Abstract

Behaviors of Holstein-Friesian (HF), Brown Swiss (BS) and Simmental (SIM) bulls were determined under the Mediterranean conditions for a period of six months. A total of35 bulls were fed in two groups (10 HF and 8 BS in group I and 10 SIM and 7 HF bulls in group II). At the time of high feed consumption, the tendency to drink water from all breeds was also high and HF bulls had higher drinking and elimination behavior rates than those of BS and SIMbulls especially in hot summer months. All breeds preferred to perform locomotor activities late in the evening during the hot summer months. The bulls decreased feeding, standing and locomotion activities during hot hours at a lower rate or postponed these behaviors to the cooler hours of the day, but they increased lying and rumination activities in those hours. While HF bulls were more affected by higher temperatures than SIM and BS bulls, taking precautions against high temperature on farms level would lead to increase the fattening performance and also the welfare of the bulls.

Key words**:** *behavioral changes, cattle breeds, fattening, heat stress.*

INTRODUCTION

In beef production, more importance has been given to the genetic improvement and nutrition, however, environmental factors and animal welfare aspects were generally pushed into the secondary plan. It is admitted that the studies on the behaviors of fattening cattle have been neglected for a long time but, there has been an increasing interest on the behaviors of fattening cattle (Brown-Brandl et al., 2006). In earlier studies, under hot environmental conditions, the behavioral changes in fattening bulls (Dikmen, 2013; Rosselle et al., 2013; Zgur et al., 2014), in heifers (Mitlöhner et al., 2001; Mitlöhner et al., 2002), in steers (Tapki, 2012) and in dairy cows (Tapki and Sahin, 2006) were determined. In these studies, the changes of losing appetite and decreasing feed intake, activity (Brown-Brandl et al., 2006), increasing water intake (Mitlöhner et al., 2002, Dikmen, 2013) and spending more time for standing (Cook et al., 2007) were mentioned. However, no studies were conducted to determine the behaviors of the three most common cattle breeds, Holstein-Friesian (HF), Brown Swiss (BS) and Simmental (SIM) bulls. Therefore, in this study the effects of environmental factors on the behaviors of fattening bulls and behavioral differences among HF, BS and SIM bulls under the Mediterranean climatic conditions by using scan sampling technique were aimed to be determined.

MATERIALS AND METHODS

This study was performed with the ethical permission (IX. Session held on October 8, 2013) of ADU-HADYEK. The study was carried out at a farm located at 37°46'55.2''N and 28°4'9.12''E in Turkey. Temperature Humidity Index (THI) was calculated by using the temperature and relative humidity records (HOBO U10) in the barn (Kibler, 1964).

In group I, 10 HF and 8 BS, in group II, 10 SIM and 7 HF bulls aged 8-12 months old were fed in two paddocks. Each paddock area was 120 m^2. Rumination, standing, lying, walking, feeding, drinking, mounting, agonistic, defecation and urination behaviors of the bulls were monitored every Monday for one hour at 06:00, 09:00, 12:00, 14:00, 17:00, 20:00 and 23:00 for 10 min period from February to August by using scanning sampling technique (Mitlöhner et al., 2001; Mitlöhner et al., 2002; Dikmen, 2013). The animals were fed with

wheat straw, tomato meal (24% DM), barley flakes and concentrates. The feed intake, nutrient components of ration, fattening performance, carcass and beef quality of the bulls were reported in another study by Çatıkkaş and Koç (2017).

Prior to the statistical analysis of the data, an arcsine-square root transformation was performed on the behavioral data (Mitlöhner et al., 2001). Statistical analysis of data was performed with using PROC GLM procedure of Statistical Analysis System (SAS, 1999). The differences between LSMEANS of the fixed factor levels were taken into account to be statistically significant at $P<0.05$ (2-tailed) based on Tukey's adjustment type I error rate. Statistical model used for the analysis of data is given in Equation I as follow:

$$y_{ijkl}=\mu+a_i+b_j+c_k+(ab)_{ij}+(ac)_{ik}+(bc)_{jk}+e_{ijkl} \quad (1)$$

where μ is the overall mean, y_{ijkl} is the observation of the behavior, a_i is the breed effects (i=HF, BS and SIM), b_j is the month effects (j=February, March, …… and August), c_k is the observation hour effects (k=06:00, 09:00, 12:00, 14:00, 17:00, 20:00 and 23:00), $(ab)_{ij}$ is breed (x) month and $(ac)_{ik}$ is breed (x) observation hour, $(bc)_{jk}$ is month (x) observation hour interaction effects and e_{ijkl} is the residual random errors.

RESULTS AND DISCUSSION

Climatic conditions: From June till the end of fattening period, the THI values (Figure 1) were over the threshold level (THI=72) of heat stress in cattle (Ravagnolo and Misztal, 2000; Gantner et al., 2011) and the behaviors of the bulls were affected more or less from the heat stress.

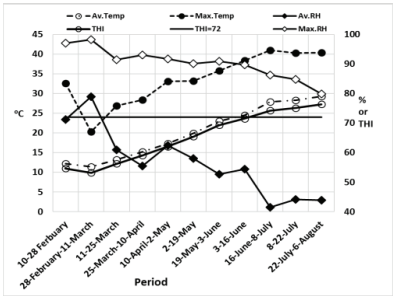

Figure 1. Average and maximum temperature (°C), relative humidity (RH, %) and temperature humidity index (THI) during fattening.

It can be said that the bulls in the last three months of the fattening were under thermal comfortless conditions and the physiological, biochemical and behaviors of them could be significantly affected (Rosselle et al., 2013; Umpapol et al., 2014). To decrease the effect of heat stress on the farm level some precautions like providing cool water, changing the ration formulation, establishing evaporative cooling system and etc. need to be taken on this farm and in all the farms of the region.

Behavioral characteristics in group I and II are given in Table 1 and 2, respectively. The daily activities in both groups were mainly similar. The highest daily activities in both groups were lying with about 35% and standing for more than 30% (Figure 2).

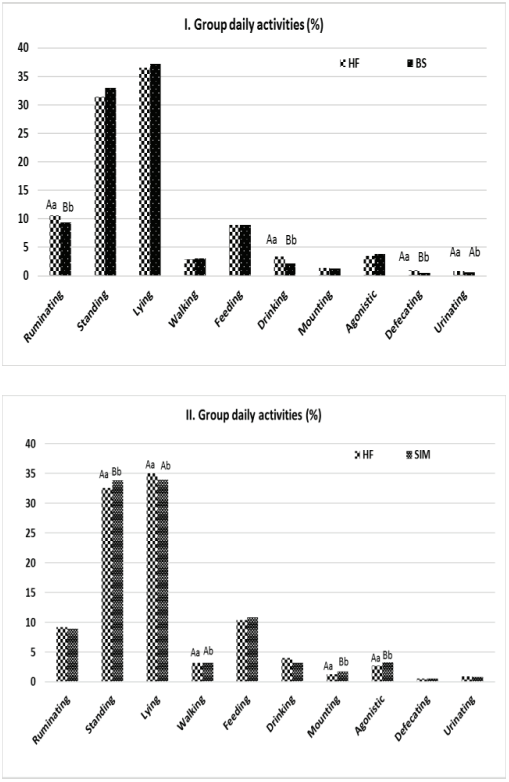

Figure 2. Daily activities (%) of HF, BS and SIM bulls. Different letters show differences between the breeds, A, B for $P<0.01$; a, b for $P<0.05$.

Table 1. Behavioral characteristics in group I

Factor	Feeding	Ruminating	Drinking	Walking	Lying	Standing	Mounting	Agonistic	Defecating	Urinating
Breed	NS	**	**	NS	NS	NS	NS	NS	**	*
HF	0.089±0.003	0.106±0.003^{Aa}	0.034±0.002^{Aa}	0.030±0.002	0.365±0.007	0.314±0.006	0.014±0.001	0.035±0.002	0.009±0.001^{Aa}	0.008±0.001^{Aa}
BS	0.089±0.003	0.094±0.003^{Bb}	0.022±0.002^{Bb}	0.031±0.002	0.372±0.007	0.330±0.006	0.013±0.001	0.038±0.002	0.005±0.001^{Bb}	0.006±0.001^{Ab}
Hour	**	**	**	**	**	**	**	**	**	**
06:00	0.045±0.006^{ACa}	0.178±0.006^{Aa}	0.010±0.003^{a}	0.010±0.003^{Aa}	0.580±0.014^{Aa}	0.153±0.011^{Aa}	0.004±0.002^{ABac}	0.004±0.004^{Aa}	0.005±0.002^{Aac}	0.004±0.002^{Aa}
09:00	0.199±0.006^{Bb}	0.043±0.006^{Bb}	0.044±0.003^{Bb}	0.039±0.003^{BDbd}	0.133±0.014^{Bb}	0.471±0.011^{Bb}	0.015±0.002^{ADbe}	0.038±0.004^{BCbd}	0.010±0.002^{Ab}	0.007±0.002^{ABab}
12:00	0.065±0.006^{AEce}	0.134±0.006^{ACc}	0.031±0.003^{Bbc}	0.034±0.003^{BCDb}	0.222±0.014^{Cc}	0.434±0.011^{BDbd}	0.013±0.002^{ABEab}	0.046±0.004^{Bb}	0.010±0.002^{Aab}	0.008±0.002^{ABab}
14:00	0.024±0.006^{Cd}	0.126±0.006^{Cce}	0.017±0.003^{ACad}	0.018±0.003^{ACac}	0.635±0.014^{Aa}	0.143±0.011^{Aa}	0.003±0.002^{Bc}	0.023±0.004^{ACc}	0.005±0.002^{Aabd}	0.003±0.002^{Aa}
17:00	0.150±0.006^{De}	0.069±0.006^{Dd}	0.030±0.003^{BCbc}	0.030±0.003^{BCb}	0.281±0.014^{Cc}	0.391±0.011^{Cc}	0.006±0.002^{ABac}	0.029±0.004^{BCcd}	0.007±0.002^{Aabd}	0.003±0.002^{Aa}
20:00	0.080±0.006^{Ec}	0.042±0.006^{Bb}	0.032±0.003^{Bbc}	0.046±0.003^{Dd}	0.272±0.014^{Cc}	0.409±0.011^{CDcd}	0.029±0.002^{Cd}	0.077±0.004^{De}	0.004±0.002^{Aabd}	0.007±0.002^{ABab}
23:00	0.057±0.006^{AEae}	0.100±0.006^{CDe}	0.027±0.003^{BCcd}	0.038±0.003^{BDbcd}	0.453±0.014^{Dd}	0.247±0.011^{Ee}	0.023±0.002^{CDEde}	0.036±0.004^{Bbd}	0.004±0.002^{Acd}	0.012±0.002^{Bb}
Month	NS	**	**	**	NS	**	**	**	NS	NS
February	0.102±0.006^{Aa}	0.125±0.006^{Aa}	0.024±0.003^{ABab}	0.015±0.003^{Aa}	0.372±0.015	0.321±0.013^{ACa}	0.010±0.002^{Aa}	0.018±0.004^{ADad}	0.008±0.002	0.007±0.002
March	0.094±0.004^{Aa}	0.095±0.004^{Aa}	0.023±0.002^{Aa}	0.031±0.002^{BCb}	0.347±0.010	0.344±0.008^{ABa}	0.012±0.002^{Aa}	0.038±0.003^{BCEbc}	0.008±0.001	0.009±0.001
April	0.082±0.004^{Aa}	0.102±0.005^{Aa}	0.016±0.002^{Aa}	0.042±0.002^{Bbc}	0.376±0.011	0.306±0.009^{ACa}	0.017±0.002^{ABab}	0.047±0.003^{Bbc}	0.005±0.001	0.005±0.001
May	0.085±0.004^{Aa}	0.076±0.004^{Bb}	0.033±0.002^{BCb}	0.042±0.002^{Bc}	0.383±0.010	0.309±0.008^{ACa}	0.022±0.002^{Bb}	0.043±0.003^{Bb}	0.004±0.001	0.004±0.001
June	0.086±0.004^{Bb}	0.058±0.005^{Bc}	0.042±0.002^{Cc}	0.040±0.002^{Bc}	0.226±0.011	0.367±0.008^{Bc}	0.011±0.002^{Aa}	0.057±0.003^{ACac}	0.008±0.001	0.006±0.001
July	0.085±0.009^{Aa}	0.141±0.009^{Aa}	0.028±0.004^{ABCab}	0.016±0.005^{ACa}	0.407±0.022	0.283±0.018^{Ca}	0.010±0.003^{Aa}	0.017±0.006^{DEd}	0.008±0.002	0.009±0.002
BreedxHour	NS	NS	NS	**	**	NS	NS	**	NS	NS
BreedxMonth	NS	NS	**	NS	NS	NS	NS	NS	*	NS
HourxMonth	**	**	**	**	**	**	**	**	*	*

HF: Holstein-Friesian, BS: Brown-Swiss, NS: not significant, *: p<0.05, **: p<0.01; A,B,C,D,E: Same letter in the column show insignificance for P<0.01, a,b,c,d,e: Same letter in the column show insignificance for P<0.05.

Table 2. Behavioral characteristics in group II

Factor	Feeding	Ruminating	Drinking	Walking	Lying	Standing	Mounting	Agonistic	Defecating	Urinating
Breed	NS	NS	NS	*	*	**	**	NS	NS	NS
HF	0.104±0.003	0.092±0.003	0.040±0.002	0.031±0.002^{Aa}	0.350±0.007^{Aa}	0.326±0.005^{Aa}	0.013±0.001^{Aa}	0.027±0.002^{Aa}	0.006±0.001	0.009±0.002
SIM	0.108±0.003	0.089±0.003	0.032±0.002	0.032±0.002^{Ab}	0.339±0.007^{Ab}	0.338±0.005^{Bb}	0.017±0.001^{Bb}	0.033±0.002^{Bb}	0.006±0.001	0.008±0.002
Hour	**	**	**	**	**	**	**	**	**	**
06:00	0.067±0.006^{Aa}	0.124±0.005^{Aad}	0.027±0.003^{Aa}	0.023±0.003^{Aa}	0.481±0.013^{Aa}	0.239±0.010^{AEa}	0.009±0.002^{Aa}	0.013±0.003^{Aa}	0.007±0.001^{ABac}	0.010±0.001^{ABad}
09:00	0.232±0.006^{Bb}	0.033±0.005^{Bb}	0.047±0.003^{Bb}	0.035±0.003^{Bb}	0.110±0.013^{Bb}	0.482±0.010^{Bb}	0.016±0.002^{Bb}	0.035±0.003^{Bbe}	0.006±0.001^{ABac}	0.006±0.001^{ACac}
12:00	0.041±0.006^{Cc}	0.129±0.005^{Aa}	0.035±0.003^{ACac}	0.038±0.003^{Bb}	0.352±0.013^{Cc}	0.339±0.010^{Cc}	0.012±0.002^{ABa}	0.028±0.003^{BCbc}	0.011±0.001^{Aa}	0.016±0.001^{Bb}
14:00	0.017±0.006^{Dd}	0.117±0.005^{Aad}	0.039±0.003^{ACc}	0.021±0.003^{Aa}	0.544±0.013^{Dd}	0.227±0.010^{Ad}	0.008±0.002^{Aa}	0.021±0.003^{Aa}	0.002±0.001^{Bb}	0.004±0.001^{Cc}
17:00	0.202±0.006^{Ee}	0.059±0.005^{Cc}	0.038±0.003^{BCbc}	0.024±0.003^{Aa}	0.287±0.013^{Ee}	0.353±0.010^{Cc}	0.010±0.002^{Aa}	0.019±0.003^{ACac}	0.004±0.001^{BCbc}	0.004±0.001^{Cc}
20:00	0.121±0.006^{Ff}	0.062±0.005^{Cc}	0.032±0.003^{ACac}	0.050±0.003^{Cc}	0.213±0.013^{Ff}	0.426±0.010^{De}	0.026±0.002^{Cc}	0.062±0.003^{Dd}	0.005±0.001^{BCbc}	0.007±0.001^{ACacd}
23:00	0.063±0.006^{ACac}	0.110±0.005^{Ad}	0.034±0.003^{ACc}	0.033±0.003^{Bb}	0.423±0.013^{Ag}	0.260±0.010^{Ea}	0.026±0.002^{Cc}	0.034±0.003^{Be}	0.007±0.001^{ACac}	0.011±0.001^{ABd}
Month	**	**	**	**	**	**	**	**	**	**
February	0.111±0.006^{ABab}	0.116±0.006^{ADade}	0.021±0.003^{Aa}	0.023±0.004^{Aa}	0.360±0.014^{ABab}	0.326±0.011^{Aa}	0.016±0.003^{ABacd}	0.010±0.004^{Aa}	0.009±0.002^{ABa}	0.009±0.001^{ABac}
Marc	0.099±0.004^{ABa}	0.110±0.004^{Aa}	0.022±0.002^{Aa}	0.033±0.002^{Bb}	0.383±0.009^{Aac}	0.297±0.007^{Aa}	0.011±0.002^{Ab}	0.030±0.002^{Bb}	0.009±0.001^{Aac}	0.006±0.001^{ACac}
April	0.098±0.005^{ACac}	0.100±0.004^{ADad}	0.019±0.002^{Aa}	0.039±0.003^{Bb}	0.363±0.010^{ACac}	0.306±0.008^{Aa}	0.019±0.002^{BCac}	0.049±0.003^{Cc}	0.004±0.001^{BCb}	0.004±0.001^{Aa}
May	0.094±0.004^{ABa}	0.074±0.004^{Bb}	0.040±0.002^{Bb}	0.039±0.002^{Bb}	0.381±0.009^{Aa}	0.297±0.007^{Aa}	0.023±0.002^{Ba}	0.046±0.003^{Cc}	0.003±0.001^{Cb}	0.006±0.001^{ACac}
June	0.075±0.005^{Bb}	0.059±0.004^{Cc}	0.035±0.002^{Bb}	0.053±0.003^{Cc}	0.327±0.010^{Bb}	0.371±0.008^{Bb}	0.015±0.002^{ACce}	0.055±0.003^{Cc}	0.005±0.001^{BCcd}	0.008±0.001^{ACac}
July	0.128±0.005^{CDcd}	0.096±0.004^{ADde}	0.049±0.002^{Cc}	0.021±0.003^{Aa}	0.307±0.010^{BCb}	0.353±0.008^{Bb}	0.012±0.002^{ACbde}	0.013±0.003^{Aa}	0.008±0.001^{ADa}	0.013±0.001^{Bb}
August	0.136±0.009^{Dd}	0.082±0.008^{Bdbe}	0.066±0.005^{Dd}	0.018±0.005^{Aa}	0.289±0.021^{ABbc}	0.376±0.015^{Bb}	0.010±0.004^{ACbc}	0.009±0.005^{Aa}	0.003±0.002^{BCDbd}	0.011±0.002^{BCbc}
Breed x Hour	NS	**	**	*	NS	NS	**	*	**	**
Breed x Month	*	**	**	**	NS	*	NS	**	NS	NS
Hour x Month	**	**	**	**	**	**	**	**	**	**

HF: Holstein-Friesian, SIM: Simmental, NS: not significant, *: p<0.05, **: p<0.01; A,B,C,D,E: Same letter in the column show insignificance for P<0.01, a,b,c,d,e,f: Same letter in the column show insignificance for P<0.05.

These behaviors were followed by nutritional activities. In both groups, feeding, ruminating and drinking activities occupied more than 20% of the bulls' time.

Nutritional, standing and lying behaviors of HF, BS and SIM bulls were mainly similar. The feed intake behavior increased at 09:00 and 17:00 and the bulls preferred drinking at the time when they had higher feeding rates. Ruminating behavior rate was lower at 09:00 and 17:00 and 20:00 due to higher feeding activities at this time (Figure 3). Except for August in group II, HF bulls had lower standing rates than those of BS and SIM bulls. HF bulls had higher lying rate in July and in August than those of the BS and SIM bulls and unlike the group I, the lying rates in group II were decreased from May to August for HF and SIM breeds.

As the ruminating and feeding behaviors decreased gradually from February to July, except for BS bulls in July, the drinking activity was increased in hot summer months for all breeds. Similar to Dikmen (2013) a higher drinking rate for HF bulls than those of BS bulls was detected.

The lower ruminating behavior rate at 09:00 and 17:00 and 20:00 due to feeding activities at this time (Figure 3)agree with Zgur et al. (2014) with the study about Sloven Cika and SIM bulls and Dikmen (2013) with the study about HF and BS bulls. The higher ruminating rates found for HF and BS in group I than those of HF and SIM bulls in group II could be due to longer fattening time of group II in hot weathers. During this time, the animals tend to decrease feed intake especially forages to decrease the heat load. The higher feeding rate found in the morning and in the evening in this study was also similar to Mitlöhner et al. (2001).

The lower standing rate found early in the morning and late in the evening and higher standing rates at 09:00 and 17:00-20:00 agree with Dikmen (2013).Similar to Platz et al. (2007)the lying behavior is the highest daily behavior and similar to the Dikmen (2013) the different lying behavior rates between HF and BS breeds were detected.

Locomotor behaviors in all breeds decreased significantly in July and August (Figure 4), due to higher temperature seen in the region. In these months because of THI >72, the bulls might have heat stress and in order to decrease heat load on their bodies, they reduced their locomotor activities. Similar to Mitlöhner et al. (2001) and Dikmen (2013), the locomotor activities of the bulls were intense during the evening hours.

Eliminating behaviors: For almost all hours the defecation and urinating rates for HF bulls in group I were higher than those of BS bulls ($P<0.05$). In group II, only in the evening the elimination rates were obviously higher in HF bulls than that of SIM bulls. In hot summer months, the elimination rates were higher in HF bulls than those of BS and SIM bulls. The higher eliminating behavior found for HF bulls than BS bulls disagree with the results of Dikmen (2013).

CONCLUSIONS

The increase in THI in hot summer months showed that the animals were exposed to heat stress and as a response to heat stress the bulls performed some of their behaviors like decreasing feeding, standing and locomotion and increasing drinking and eliminating behaviors or postponing these behaviors to the cooler hours of the day. In terms of drinking, defecation and urination, BS bulls could be more resistant to higher environmental temperatures and relative humidity than those of HF bulls, however the behavioral differences were not obvious between HF and SIM bulls.

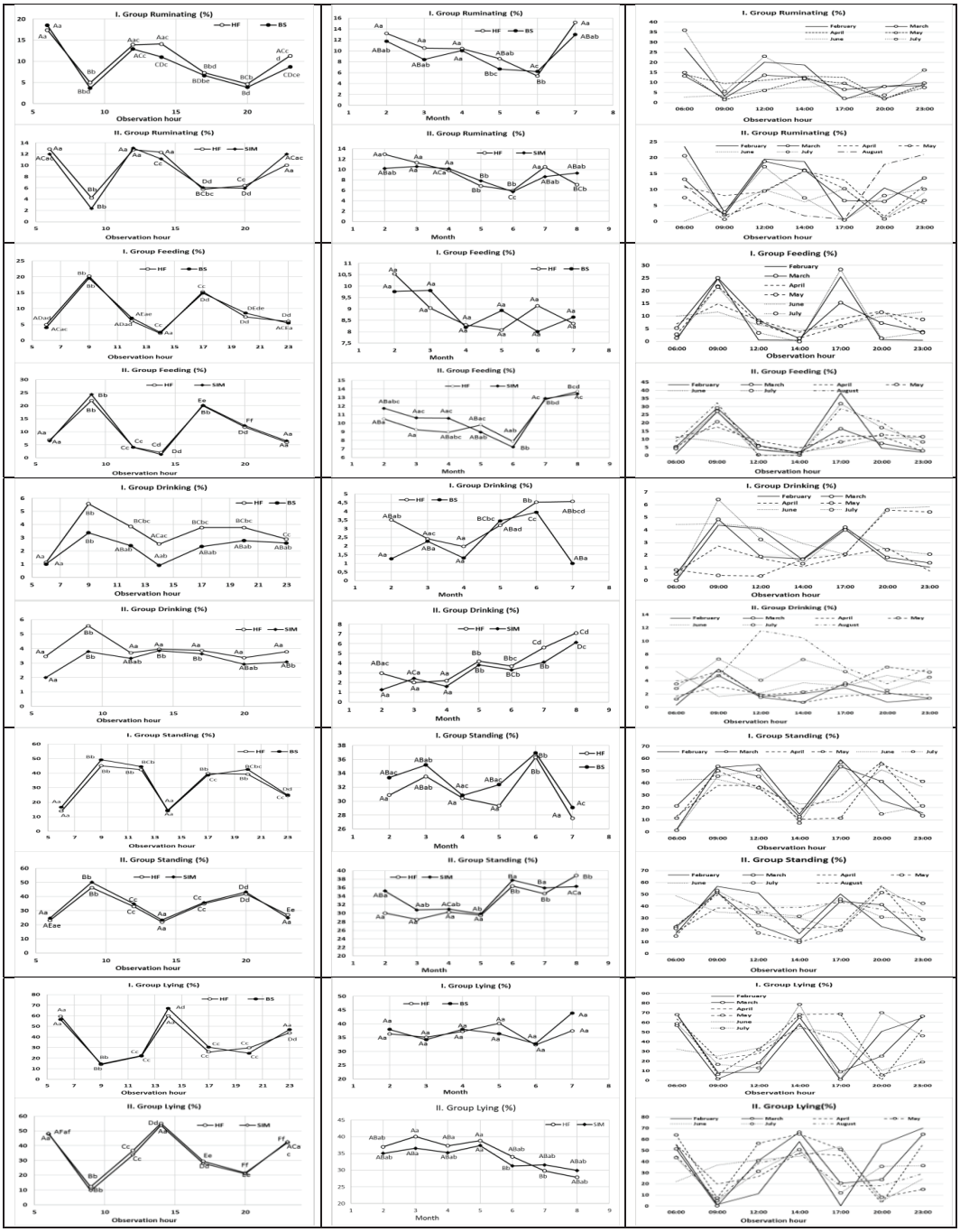

Figure 3. Changes of nutritional, standing and lying behaviors of HF, BS and SIM depending on observation hour and month.

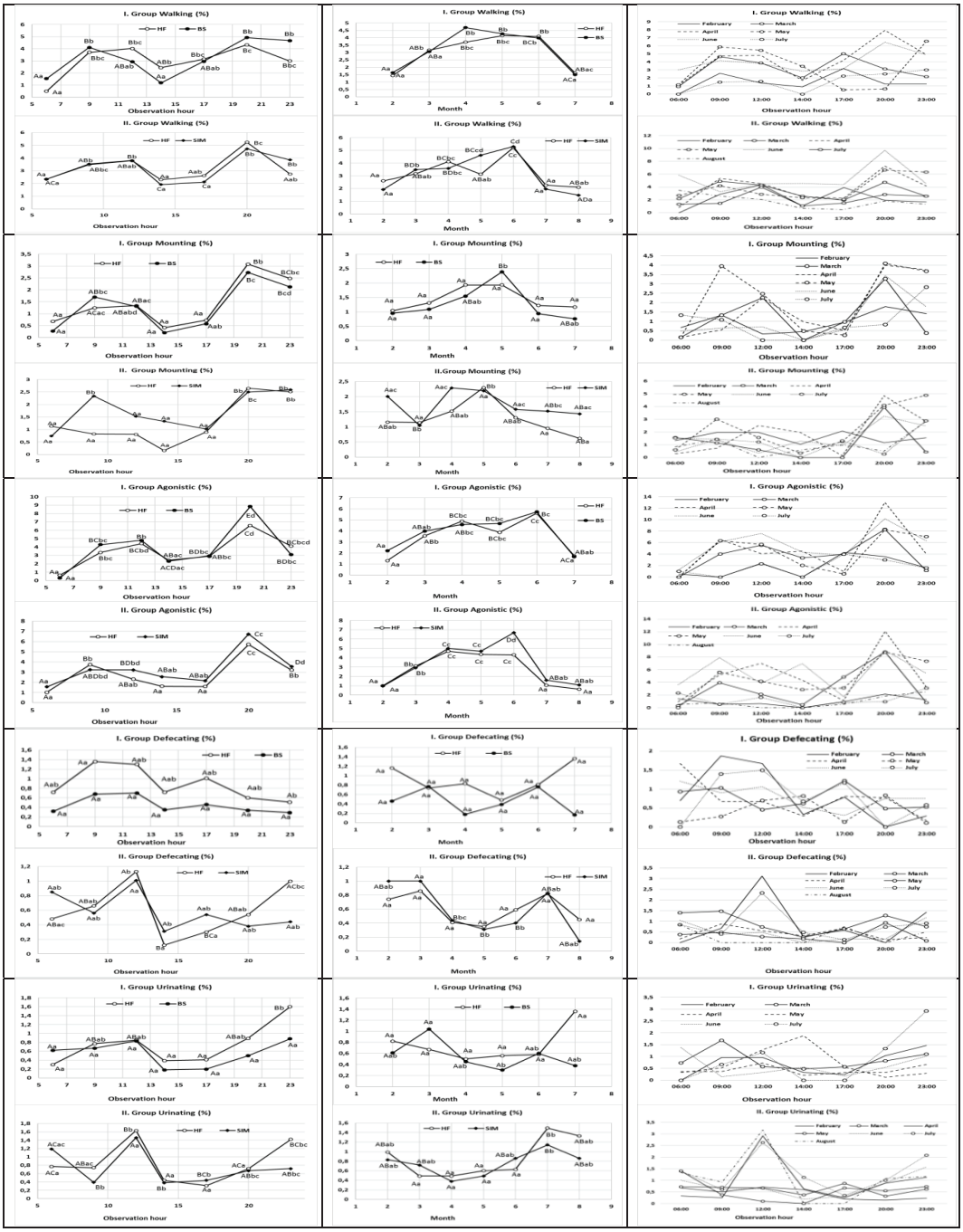

Figure 4. Changes of locomotion and eliminating behaviors of HF, BS and SIM depending on observation hour and month.

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