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Research Paper

Changes of Linear Type Trait Scores in Simmental Cows

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ABSRACT: *Revealing the associations of linear type traits will gain important information to dairy cow selection for elite herds. The aim of the present study was to investigate the changes of linear type traits in Simmental cows reared at Gokhoyuk State Farm of Turkey. A total of 621 scoring records were costituted as the work material. Of traits, body condition scores (BCS) were performed by a 1 to 5 scale and body, udder and leg-foot traits were scored by a 1 to 9 scale. Calving season, calving age (from 2 to 6), BCS (1= 2-3, 2=3.25-4 and 3=4.25-5) and stage of lactation (1=70±14d, 2=140±14d and 3=210±14d) were used to be non-genetic factors affecting type traits. While many body, udder and leg-foot type traits were significantly influenced by the non-genetic factors, especially calving age and BCS had more effect on the type traits. Also, the traits had negative or positive correlation coefficients each other. As the result, close tracking BCS, especially with advancing age should be seen as the main issue of dairy owners to prevent adverse effects of environmental factors on linear type traits of dairy cows.*

Keywords*: body condition, dairy cow, environmental factor, type traits*

I. INTRODUCTION

Evaluation of dairy cows by linear type characteristics has been used to select elite cows and culling process in many dairy farms [1]. Some investigators [2] especially emphasized that improvement of linear type traits through genetic or herd management tools would have a positive effect on the functional length of productivity. To assess linear scores, dairy cows are pointed by body structure, dairy form (DF), foot-legs and udder structure [3]. In addition to these characteristics, body condition scores (BCS) records of cows have widely been used to be selection criteria by herd owners. Actually, BCS or body energy reserve of cows informs the general regime of feeding applications in the herds and it has been reported that BCS are associated with milk yield and milk composition [4]. Besides, a low to moderate genetic correlations of different type traits with longevity was informed in the field investigations [5]. At this point, revealing the relationships of various linear type traits with each other may be seen a key approach to achieve more productive cattle population. Up to now, some studies have been conducted on the importance of type traits and factors affecting these characters [1,2,3]. Besides, there is still a lack of the information on the change of linear type traits throughout the production period especially in Simmental cows.

The objective of the present investigation was to reveal the changes of linear type traits in Simmental cows in Turkey conditions.

II. MATERIALS AND METHODS

Simmental cows reared at Gokhoyuk State Farm of Amasya province of Turkey and their production records were used to be investigation material. The farm was visited with 28 daily intervals to determine calved cows, and these cows were scored by body characteristics. Scorings were performed according to [2,6,7] by the same assessor on a total of 621 evaluations. Of the traits, body condition score (BCS) record were noted using a 1 to 5 scale (1: too poor and 5: too fatty) where half and quarter points were given if needed, and other traits were scored by a 1 to 9 scale. In the evaluation, the following traits were regarded for body, udder and foot structures: BCS, dairy form (DF), rump height (RH), body depth (BD), rump width (RW), rump angle (RA), hearth width (HW), rear legs angle (RLA), claw diagonal (CD), rear hock status (RHS), rear legs set (RLS), fore udder attachment (FUA), teat placement (TP), teat length (TL), teat depth (TD), rear udder height (RUH) and central ligament (CL). Average scores of three stage of lactation periods were calculated and the mean scores for entire lactation were determined. The traits evaluated in three BCS

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(1=BCS 2-3; 2=3.25-4.0 and 3=4.25-5), three stage of lactation (70±14, 140±14 and 210±14 d), four calving season (winter, spring, summer and autumn) and five calving age (from 2 to 6≤) groups to determine effects of non-genetic factors. To statistical analyze, the following linear model was applied:

$Y_{ijklm}=\mu+a_i+b_j+c_k+d_l+e_{ijklm}$

where; Y_{ijklm}: observation value, μ: overall mean, a_i: effect of calving season, b_j: effect of calving age, c_k: effect of BCS, d_l: effect of stage of lactation and e_{ijklm}: error term. To compare the means, Duncan's multiple comparison test method was performed. Also, correlation coefficients were estimated to determine the relationships among the investigated traits. All statistical works were carried out by SPSS 17.0 for Windows package program.

III. RESULTS AND DISCUSSION

As a general statement, DF has been referred to be adaptation of milking cows within the breed and suitability for milk production. It may be determined by observing the angle of withers towards to the sides. In the assessment, extremely steep angle has been recorded as 9 points and this case has been assumed as desirable, and structure of withers with extremely rough-muscle has been noted to be 1 point. In the present study, the mean for DF was obtained to be 4.76 (Table 1) and this value indicated to a moderate level. As seen that all non-genetic factors had significant effect ($P<0.05$ or $P<0.001$) on DF. Relatively higher DF means were obtained in the autumn and winter when compared to other seasons. This finding might be explained by more feeding conditions of the farm and elevated conditions of the cows due to restricted moving areas in those months. Similarly, the highest mean was calculated from first parity (2 aged) cows, but the difference was only observed between 2 and 5 aged cows in the study. Really, more suitable body structures for more productivity with advanced age might be expected from dairy cows. In the study, DF was the lowest in the first BCS group. Actually, this case could gain an advantage for cows in the 1st BCS group. The well-known concept that cows with higher BCS tend to have rough wither angle and thus, DF tend to worsen. A similar case was determined for lactation periods (Table 1) and DF had an ideal level (5 points) with advanced stage of lactation. This result might be caused from lower BCS of cows during the early lactation period.

RA, one of the body traits, was not affected by any environmental factor (Table 1). Actually, RT may be associated with calving ease and a 5 point has been assumed to be the ideal score for dairy cows. Similarly, stage of lactation was not an effective factor on RH, BD and RW, which had been selected as the other body traits. However, HW was affected ($P<0.01$) by stage of lactation and the scores tended to elevate with later periods. This result might be explained by regaining BCS, picking up body reserves and advanced gestation period with the later lactation stages. As parallel to RA, RH was not affected by seasonal effects, nevertheless, BD, RW and HW were significantly ($P<0.05$) influenced by season and as a general view, the means reached to highest levels in the winter and summer. Besides, calving age differed ($P<0.001$) RH, BD, HW and RW, and the traits tended to advance with the later ages. This case could be stated to be the progressing of growth up to 5 or 6 ages that is known as mature equivalent for dairy cows. Similar results were obtained for BCS groups and RH ($P<0.05$), BD, HW and RW ($P<0.01$) had highest in cows with higher BCS. Really, because of the gaining more weight could be associated with BCS, increments in investigating body traits with BCS might be assumed to be an expected result. In addition, the body traits were reached nearby to 5 points that indicates the ideal score, and at this point, a fairly well population might be noticed for the examined herd.

As seen from Table 1, RLA, CD, RHS and RLS were evaluated by a 1 to 9 scale to determine foot and leg trait scores. Of the traits, only CD was influenced by age ($P<0.05$) and this parameter had tended to drop with advancing age. In the present study, udder structure traits were also examined (Table 2). Of these, FUA was affected by season and BCS at the 0.01 significance level, calving age affected this trait at the level of 0.001. Really, drooping FUA with later calving age might be regarded as an expected case due to erosions of ligaments and mammary gland related to parturitions. Finally, FUA might become thin and tended to prolapse towards to ground. However, stage of lactation and BCS had no significant effect on FUA. While season affected TP, UD and RUH, BCS only affected RUH and CL ($P<0.05$). Similarly, RUH and CL scores dropped with advanced stage of lactation. This finding might be caused by weakening of ligaments and contraction of mammary gland with advancing lactation. Besides, TL, UD, RUH and CL changed ($P<0.001$) with animal age in this study. The elevation in TL scores with age might be explained by adverse effect of milking applications on the teats throughout years. Other three udder traits (UD, RUH and CL) dropped with animal age and tended to become distant from the suitable scores.

To reveal the associations among body, udder, foot and leg structures, correlation coefficients were estimated (Table 3). As seen, a moderate ($r= -0.420$) correlation was determined between TL and UD. Similarly, RUH correlated with FUA, UD, DF and CL, and RH correlated with BD and RW. Positive and significant correlation coefficients were also found between BD and RW, RHS and RLS, HW and RH, and BD and RW. The other coefficients had lower according to analysis results.

IV. CONCLUSIONS

The results of the study clearly pointed out that linear type traits of Simmental cows investigated here were found to be close to the average scores for dairy cows. In other words, breeder Simmental cows reared at Gokhoyuk Farm had suitable type structures. In spite of each body trait of cows was affected by different non-genetic factors, calving age and BCS had more effect to the traits. At this point, changes of type traits according to age and BCS or depositing energy were relatively more effective on many characters. Also, some type traits were changed with different calving season and stage of lactation. Finally, close observing BCS of dairy cows, especially with advancing age should be seen as the main topic of dairy owners to prevent negative effects of non-genetic factors on the productivity of herds.

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Table 1. Changes of body structure, foot and leg traits by environmental factors

Factor	DF	RH	BD	RW	RA	HW	RLA	CD	RHS	RLS
	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx
Season	*	ns	*	*	ns	*	ns	ns	ns	ns
Winter	4.76±0,08^{ab}	4.76±0.05	4.64±0.06^{b}	4.75±0.05^{b}	4.94±0,05	4.53±0,05^{b}	4.83±0.05	4.54±0.05	4.86±0.03	4.80±0.04
Spring	4.61±0,06^{a}	4.76±0.04	4.51±0.05^{ab}	4.63±0.04^{ab}	4.84±0.05	4.41±0,04^{ab}	4.94±0.05	4.62±0.04	4.83±0.03	4.78±0.04
Summer	4.58±0.07^{a}	4.76±0.04	4.60±0.05^{b}	4.73±0.04^{b}	4.99±0.05	4.49±0.04^{b}	4.90±0.04	4.60±0.05	4.90±0.03	4.83±0.04
Autumn	4.87±0.10^{b}	4.69±0.06	4.38±0.07^{a}	4.58±0.06^{a}	4.99±0.07	4.35±0.06^{a}	4.92±0.07	4.67±0.05	4.78±0.05	4.76±0.05
Total	4.76±0.08	4.76±0.05	4.64±0.06	4.75±0.05	4.94±0.05	4.53±0.05	4.83±0.05	4.54±0.05	4.86±0.03	4.80±0.04
Calving age	***	***	***	***	ns	***	ns	*	ns	ns
2	5.01±0.09^{b}	4.49±0.06^{a}	4.20±0.06^{a}	4.44±0.06^{a}	5.00±0.06	4.17±0.05^{a}	5.02±0.07	4.70±0.06^{b}	4.86±0.04	4.86±0.05
3	4.90±0.07^{ab}	4.57±0.04^{ab}	4.25±0.05^{a}	4.45±0.05^{a}	4.86±0.05	4.22±0.04^{a}	4.90±0.05	4.71±0.04^{b}	4.88±0.03	4.82±0.04
4	4.57±0.08^{ab}	4.81±0.05^{bc}	4.60±0.06^{b}	4.77±0.05^{b}	4.86±0.06	4.55±0.05^{b}	4.88±0.05	4.63±0.06^{ab}	4.92±0.03	4.81±0.05
5	4.49±0.10^{a}	4.81±0.06^{bc}	4.66±0.06^{b}	4.80±0,06^{b}	4.96±0.07	4.52±0.06^{b}	4.92±0.06	4.56±0.06^{ab}	4.88±0.04	4.81±0.05
6	4.60±0.11^{ab}	4.95±0.0^{dc}	4.81±0.09^{b}	4.88±0.06^{b}	4.95±0.10	4.69±0.08^{b}	4.74±0.10	4.48±0.08^{a}	4.76±0.07	4.64±0.08
Total	4.73±0.04	4.69±0.03	4.46±0.03	4.64±0.03	4.92±0.03	4.39±0.03	4.91±0.03	4.64±0.02	4.88±0.02	4.81±0.02
BCS	***	*	***	***	ns	***	ns	ns	ns	ns
1 (2-3)	3.89±0.14^{a}	4.72±0.04^{a}	4.52±0.05^{a}	4.60±0.04^{a}	4.96±0.05	4.39±0.04^{a}	4.90±0.04	4.56±0.04	4.83±0.03	4.79±0.03
2 (3.25-4)	4.62±0.05^{b}	4.74±0.03^{a}	4.51±0.03^{a}	4.67±0.03^{a}	4.93±0.03	4.42±0.03^{a}	4.90±0.03	4.62±0.03	4.87±0.02	4.82±0.03
3 (4.25-5)	4.98±0.06^{b}	4.95±0.07^{b}	4.95±0.11^{b}	5.12±0.09^{b}	4.86±0.09	5.05±0.08^{b}	4.84±0.11	4.63±0.09	4.79±0.08	4.67±0.09
Total	4.68±0.04	4.75±0.02	4.54±0.03	4.68±0.02	4.93±0.03	4.45±0.02	4.90±0.03	4.60±0.02	4.85±0.02	4.80±0.02
Stage of lactation	***	ns	ns	ns	ns	**	ns	ns	ns	ns
1 (70±14d)	4.45±0.06^{a}	4.72±0.04	4.48±0.05	4.63±0.04	4.91±0.04	4.39±0.04^{a}	4.88±0.04	4.62±0.04	4.87±0.03	4.82±0.03
2 (140±14d)	4.66±0.06^{ab}	4.73±0.04	4.56±0.04	4.71±0.04	4.94±0.05	4.41±0.04^{a}	4.92±0.05	4.57±0.04	4.83±0.03	4.74±0.04
3(210±14d)	4.92±0.06^{b}	4.79±0.04	4.60±0.05	4.71±0.04	4.95±0.04	4.56±0.04^{b}	4.90±0.05	4.62±0.04	4.85±0.03	4.82±0.03
Total	4.68±0.04	4.75±0.02	4.54±0.03	4.68±0.02	4.93±0.03	4.45±0.02	4.90±0.03	4.60±0.02	4.85±0.02	4.80±0.02

BCS: body condition score, DF: dairy form, RH: rump height, BD: body depth, RW: rump width, RA: rump angle, HW: hearth width, RLA: rear legs angle, CD: claw diagonal, RHS: rear hock status, RLS: rear legs set

Table 2. Changes of udder structure traits by environmental factors

Factor	FUA	TP	TL	UD	RUH	CL
	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx	X±Sx
Season	**	*	ÖS	*	*	ÖS
Winter	4.44±0.13^{ab}	3.79±0.07^{a}	5.34±0.11	4.30±0.14^{a}	4,24±0.12^{ab}	4.71±0.16
Spring	4.65±0.13^{ab}	3.88±0.05^{a}	5.28±0.10	4.73±0.13^{b}	4,14±0.10^{a}	4.48±0.12
Summer	4.19±0.12^{a}	3.80±0.07^{a}	5.17±0.10	4.25±0.13^{a}	4.05±0.11^{a}	4.54±0.13
Autumn	4.87±0.17^{b}	4.07±0.08^{b}	5.17±0.14	4.60±0.16^{ab}	4.55±0.16^{b}	4.94±0.16
Total	4.44±0.13	3.79±0.70	5.34±0.11	4.30±0.14	4.24±0.12	4.71±0.16
Calving age	***	ns	***	***	***	***
2	5.89±0.17^{c}	3.97±0.09	4.95±0.14^{ab}	5.75±0.16^{c}	5.22±0.15^{c}	5.00±0.16^{b}
3	5.45±0.12^{c}	3.86±0.07	4.71±0.11^{a}	5.50±0.11^{c}	4.92±0.10^{bc}	5.06±0.13^{b}
4	4.50±0.12^{b}	3.79±0.08	5.14±0.11^{ab}	4.68±0.13^{b}	4.32±0.12^{b}	5.02±0.16^{b}
5	3.68±0.12^{a}	3.86±0.08	5.40±0.13^{ab}	3.61±0.12^{a}	3.60±0.11^{a}	4.08±0.15^{a}
6	3.90±0.23^{ab}	3.90±0.12	5.55±0.17^{b}	3.83±0.22^{a}	3.60±0.17^{a}	4.40±0.24^{ab}
Total	4.79±0.07	3.87±0.04	5.08±0.06	4.80±0.07	4.43±0.06	4.77±0.08
BCS	**	ns	ns	ns	*	*
1 (2-3)	4.27±0.12^{ab}	3.85±0.06	5.29±0.09	4.42±0.12	4.09±0.09^{ab}	4.45±0.11^{ab}
2 (3.25-4)	4.66±0.08^{b}	3.88±0.04	5.21±0.07	4.56±0.09	4.32±0.07^{b}	4.77±0.09^{b}
3 (4.25-5)	4.11±0.31^{a}	3.84±0.13	5.23±0.22	3.93±0.30	3.80±0.27^{a}	4.27±0.32^{a}
Total	4.50±0.08	3.87±0.03	5.24±0.05	4.47±0.07	4.21±0.06	4.63±0.07
Stage of lactation	ns	ns	ns	ns	**	***
1 (70±14d)	4.30±0.11	3.87±0.06	5.34±0.09	4.40±0.12	4.43±0.10^{b}	4.99±0.12^{b}
2 (140±14d)	4.57±0.12	3.92±0.06	5.16±0.09	4.56±0.11	4.23±0.10a^{b}	4.51±0.12^{ab}
3(210±14d)	4.64±0.12	3.80±0.06	5.23±0.10	4.44±0.13	3.95±0.10^{a}	4.37±0.11^{a}
Total	4.50±0.07	3.87±0.03	5.24±0.05	4.47±0.07	4.21±0.06	4.63±0.07

BCS: body condition score, FUA: fore udder attachment, TP: teat placement, TL: teat length, UD: udder depth, RUH: rear udder height, CL: central ligament, *: P<0.05; **: P<0.01; ***: P<0.001; ns: non-significant

Table 3. Correlation coefficients among the traits

	TP	TL	UD	RUH	CL	DF	RH	BD	RW	RA	RLA	HW	CD	RHS	RLS
FUA	0.071	-0.392	0.821	0.446	0.155	0.216	-0.206	-0.263	-0.210	-0.003	0,101	-0.189	0.123	0.037	0.089
TP		0.021	0.076	0.072	0.058	0.057	0.041	-0.060	-0.053	0.028	-0,060	-0.026	0.054	0.015	-0.046
TL			-0.420	-0.265	-0.109	-0.210	0.186	0.184	0.192	0.092	-0,003	0.120	-0.031	-0.011	-0.055
UD				0.504	0.182	0.264	-0.214	-0.327	-0.305	-0.058	0,110	-0.256	0.159	0.078	0.096
RUH					0.596	0.406	-0.237	-0.349	-0.241	0.005	0,103	-0.338	0.174	0.079	0.108
CL						0.308	-0.120	-0.196	-0.078	0.018	0,077	-0.213	0.126	0.084	0.091
DF							-0.256	-0.302	-0.312	0.038	-0,064	-0.330	0.019	-0.069	-0.003
RH								0.538	0.486	0.044	-0,003	0.442	-0.047	0.084	-0.005
BD									0.629	0.076	0,011	0.697	-0.066	0.018	0.024
RW										0.068	-0,022	0.584	0.004	0.004	0.040
RA											0,183	0.106	0.184	0.129	0.184
RLA												0.005	0.170	0.224	0.233
HW													-0.124	0.024	0.030
CD														0.188	0.191
RHS															0.497

FUA: fore udder attachment, TP: teat placement, TL: teat length, UD: udder depth, RUH: rear udder height, CL: central ligament, DF: dairy form, RH: rump height, BD: body depth, RW: rump width, RA: rump angle, RLA: rear legs angle, HW: hearth width, CD: claw diagonal, RHS: rear hock status, RLS: rear legs set