INVESTIGATIONS ON THE CONFORMATION TRAITS, HERD LIFE AND MILK YIELD IN HOLSTEIN COWS

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Abstract

In this study, the relations between conformation traits, herd life and milk yield in Holstein cows were investigated. The material of this study was formed by 247 head Holstein cows in Polatli State Farm and 47 head Holstein cows in Ankara University Agricultural Faculty Research Application Farm. In this study, seventeen linear type traits on a scale of 1 to 9, and 4 general traits on a scale of 65 to 100 were scored in total 294 head Holstein cows. Stature was measured by a measuring cane. The relations between traits were investigated by Spearman's rho coefficient. The best regression equation estimating 305-day milk yield was determined by Stepwise Linear Regression Analysis The mean values of 305 day milk yield in Ankara University Agricultural Faculty Research Application Farm and Polatli State Farm were ranged between 4862-6559 kg and 6908-7847 kg, respectively. The positive and significant correlations were found between conformation traits and 305-day milk yield. These correlations indicate that an increase in 305-day milk yield could be achieved through selection on any of the conformation traits.

The mean Total score values of Holstein cows that were grown up in Ankara University Agricultural Faculty Research and Application Farm and Polatli State Farm were ranged between 76.1-76.7 and 77.2-78.0, respectively, and cows in both enterprises were classified as medium class. The positive and significant correlations between the final score and categorical type traits constituted showed that an improvement could be seen in the categorical type traits by selection on final score.

Key Words: Conformation traits, milk yield, herd life

1. Introduction

One of the most important factor influencing profit in dairy cattle breeding is the status of cows with high yield and continuation of this high yield in long term. The bodies and constitution of cows should become appropriate for continuation of high yield for long terms.

According to ICAR Guidelines, a complete linear scoring system valuable for a given breed may often includes further items such as skeletal traits, udder, and legs etc. Linear scoring may be conducted on dairy cattle. Linear scoring has the Linear Type Traits. The Linear Type Traits were classified on a scale of 1 to 9 points for Linear Type Traits. One to 15 point scale is recommended in such circumstances (Anonymous 2006). These points are stature (S), chest width (CW), body depth (BD), dairy character (DC), rump angle (RA), rump width (RW), rear leg set (RLS), rear leg angle (RLA), foot diagonal (FD), fore udder attachment (FUA), rear udder height (RUH), central ligament (CL), udder depth (UD), rear udder teat placement (RUTP) and udder teat length (UTL). Additionally these 15 character knee structure (KS) and

fore udder teat placements (FUTP) are commonly used in Turkey and consequently character numbers are 17 at linear scoring (Anonymous 2000a).

The other characters that are outside of linear type traits were called as 'General Traits'. It was suggested that points from 50 to 97 given to cows that were evaluated in terms of this characters by ICAR. Herein apart from Linear scoring, desirable circumstances are predicated on rather than actual circumstances. Namely, cows were given points for body structure (BS), dairy type (DT), foot-leg structure (FLS) and udder structure (US). The means of points were determined as follows; 90-97 perfect, 85-89 very good, 80-84 good, 75-79 intermediate and 50-74 adequate (Anonymous 2002a).

As being understood from the information given to date, evaluation of cows must be taken into account together with conformation traits and milk yields.

2. Material and methods

2.1 Material

A total of 247 head Holstein cows in Polatli State Farm (PSF) and 47 head Holstein cows in Ankara University Agricultural Faculty Research Application Farm (AUF) constituted the material of this study. In the present study, seventeen linear type traits on a scale of 1 to 9, and 4 general traits on a scale of 65 to 100 were scored total 294 head Holstein cows. Stature was measured by a measuring cane. The relations between traits were investigated by Spearman's rho coefficient (Anonymous 1998). The best regression equation estimating 305-day milk yield was determined by Stepwise Linear Regression Analysis (Ryan 1997).

2.2 Methods

Researcher was attended to a classification course managed by The Cattle Breeder's Association of Turkey before starting to classification of the work. The presenting author achieved 'Classification Expert Certificate'. Then, every farm's data were investigated cows were determined 1^{st}-5^{th} months of lactation. Cow's identification numbers, lactation numbers and late calving date were recorded from farm's recognizing. Firstly cows were carried out within Linear Scoring for 17 characters and then body structure, dairy type, foot-leg structure and udder structure on a scale of 65 to 100 were scored for all cows. The Means and Minimum and Maximum Value of Linear Scoring of Linear Type Traits for Holstein – Friesian was given in Table 1.

The scoring and measurement were started on 3 March 2004. The investigation was completed in Ankara University Agricultural Faculty Research Application Farm on 1 July 2005 and in Polatli State Farm on 4 July 2005.

Table.1. the Means and Minimum and Maximum Value of Linear Scoring of Linear Type Traits for Holstein –Friesian (Anonymous 2002b).

Linear Type Traits	Min (1)	Max (9)	Ideal
Stature, cm	Very low (130 cm)	Very high (154 cm)	145
Dairy Character	Very rough, wide	Very narrow, sharp	7-9
Body Depth	Very short	Very deep	7
Chest Width	Very narrow	Very wide.	9
Rump Width	Very narrow	Very wide.	7-9
Rump Angle	Elevating	Very lowering	5
Rear Leg Angle	Very plumb	Very narrow	5
Foot Diagonal	Very low	Very high	9
Knee Structure	Very rough	Very dry	9
Rear Leg Set	Closed knees	Parallel	5-9
Fore Udder Attachment	Very weak	Very strong	7-9
Rear Udder Height	Very low	Very high	9
Central Ligament	Very weak	Very strong	9
Udder Depth	Very low	Very high	5
Fore Udder Teat Placement	External lob	Internal lob	6
Fore Udder Teat Length	Very short	Very long	5
Rear Udder Teat Placement	Very open	Very adjacent	5

According to evaluation predicated on points for 4 general traits (BS, DT, FLS, US), it was mentioned that those characters effect on milk yield. The model of this aim was given below (Model 1). In addition, a separate model was composed for total score value (TS) that was calculated from general traits effects on 305-day milk yields (Model 2).

Model 1 : $Yijkl = \mu + s_i + bm_j + ls_k + b_{yx}. X_{ijkl} + b_{yz}. Z_{ijkl} + b_{yg}. G_{ijkl} + b_{yh}. H_{ijkl} + e_{ijkl}$

Model 2 : $Yijkl = \mu + s_i + bm_j + ls_k + b_{yo} O_{ijkl} + e_{ijkl}$

Where; Y_{ijklm}: i. farm, j. calving month, k. lactation number, l. cow's 305-day lactation milk yield, μ : population mean, s_i : i. farm's effect (i: 1, 2), bm_j : j. calving month's effect (j: 1, 2,….12), ls_k: k. lactation number's effect (k: 1, 2, 3, 4, 5, ≥ 6), X_{ijkl} : i. farm, j. calving month, k. lactation number, l. cow's dairy type score, Z_{ijkl} : i. farm, j. calving month, k. lactation number, l. cow's body structure score, G_{ijkl}: i. farm, j. calving month, k. lactation number, l. cow's foot and leg structure score, H_{ijkl} : i. farm, j. calving month, k. lactation number, l. cow's udder structure score, O_{ijkl}: i. farm, j. calving month, k. lactation number, l. cow's total score, b_{yx} : partial regression coefficient with regard to dairy type of milk yield, b_{yz}: partial regression coefficient with regard to body structure of milk yield, b_{yg}: partial regression coefficient with regard to foot and leg structure of milk yield, b_{yh}: partial regression coefficient with regard to udder structure of milk yield, b_{yo}: partial regression coefficient with regard to total point of milk yield, e_{ijklm}: residual error.

According to the evaluation predicated on points for linear type traits (17 characters), it was mentioned that those characters effect on milk yield. The model of this aim was given below (Model 3 and Model 4)

The Effects on 305-Day Milk Yield of Linear Type Traits

Model 3: $Y_{ijklm} = \mu + s_i + bm_j + ls_k + DÖ1n + b_{ny} N_{ijklm} + e_{ijklm}$

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Model 4: $Y_{ijklm} = \mu + s_i + b_{mj} + ls_k + DÖ16n + b_{ny} N_{ijklm} + + e_{ijklm}$

Where; Y_{ijklm}: i. farm, j. calving month, k. lactation number, l. classified in linear type traits, m. cow's 305-day lactation milk yield, μ : Population mean, s_i : i. farm's effect (i: 1, 2), bm_j : j. calving month's effect (j: 1, 2,….12), ls_k: k. lactation number's effect (k: 1, 2, 3, 4, 5, ≥ 6), N_{ijklm} : i. farm, j. calving month, k. lactation number, l. classified in linear type traits, m. cow's stature, b_{ny} : partial regression coefficient with S of milk yield, $DÖ1_n$: effect of DC class, (n: 1, 2,..,5), $DÖ2_n$: effect of BD class (n: 1, 2, 3, 4), $DÖ3_n$: effect of CW class (n: 1, 2, 3, 4), $DÖ4_n$: effect of RW class (n: 1, 2, 3, 4), $DÖ5_n$: effect of RA class (n: 1, 2, 3, 4), $DÖ6_n$: effect of RLA class (n: 1, 2, 3), $DÖ7_n$: effect of FD class (n: 1, 2, 3, 4), $DÖ8_n$: effect of KS class (n: 1, 2, 3, 4, 5), $DÖ9_n$: effect of RLS class (n: 1, 2, 3,….8), $DÖ10_n$: effect of FUA class (n: 1, 2, 3, 4), $DÖ11_n$: effect of RUH class (n: 1, 2, 3, 4, 5), $DÖ12_n$: effect of CL class (n: 1, 2, 3, 4, 5, 6), $DÖ13_n$: effect of UD class (n: 1, 2, 3, 4, 5), $DÖ14_n$: effect of FUTP class (n: 1, 2, 3, 4),$DÖ15_n$: effect of FUTL class (n: 1, 2, 3, 4, 5), $DÖ16_n$: effect of RUTP class (n: 1, 2, 3,….9), e_{ijklmn}: Residual error.

Results and Discussions

Ankara University Agricultural Faculty Research Application Farm (AUF) and Polatli State Farm (PSF) were given mean of 305-day milk yields are from 4862 to 6559 kg in AUF and from 6908 to 7847 in PSF in Table 2.

Table 2. The mean values of 305-day milk yields of cows in AUF and PSF ($\bar{X} \pm S_{\bar{X}}$)

FARM	AUF				PSF			
LS	N	$S_{\bar{x}} X \pm$	Min	Max	N	$S_{\bar{x}} X \pm$	Min	Max
1	10	4862 ± 715	2112	9455	36	6908 ± 279	2293	9950
2	4	5218 ± 1188	2735	7955	47	7617 ± 265	2354	11409
3	16	6559 ± 486	4083	10093	43	7730 ± 321	2992	11092
4	17	5427 ± 405	2644	9142	41	7742 ± 338	2800	10956
5	-	-	-	-	54	7847 ± 188	4724	10108
6	-	-	-	-	26	6988 ± 401	3639	12419

According to analyses, differences between lactations were non-significant in each farm ($P > 0.05$). In many studies were reported that the highest 305-day milk yield of cows were reached at 3th lactation or 4th lactation. On the other hand, other studies reported that that the highest 305-day milk yield of cows were reached 5 th and 6th (Yaylak and Kumlu 2005).

The mean values of general traits were changed from 65 to 85 in AUF and from 64 to 89 in PSF. The mean Total score valued (for general traits) were found as 76.1-76.7 and 77.2-78.0 for AUF and PSF, respectively. According to the results, cows grown in each farms were classified in the middle class.

The effects of general traits on 305-day milk yield were found non-significant (P> 0.01) and only effect of dairy type (DT) was found significant (P< 0.01). Furthermore, the differences between mean value of 305-day milk yield for farms and lactation numbers were found significant (P< 0.01).

The effects of DC-RUH (P<0.01) and CW-RLS (P<0.05) on 305-day milk yield were found significant, when the effects of linear type traits on 305-day milk yield were analyzed.

Table 3 The correlations between traits and 305-day milk yield for AUF and PSF.

FARMS	**AUF**	**PSF**
Traits	**Correlations**	**Correlations**
S	0.26	0.26**
DC	-0.11	0.19**
BD	0.10	0.11
CW	-0.06	0.009
RW	0.02	-0.03
RA	0.15	0.03
RLA	0.07	0.01
FD	0.23	-0.06
KS	0.03	-0.01
RLS	0.08	0.07
FUA	0.08	-0.11
RUH	0.03	0.12
CL	-0.12	0.007
UD	-0.06	-0.10
FUTP	0.21	-0.04
FUTL	0.10	0.05
RUTP	0.05	-0.08
DT	0.01	0.21**
BS	0.22	0.03
FLS	0.08	0.008
US	0.12	-0.07
TS	0.13	0.05

*: p<0.05, ** p<0.001, **AUF:** Ankara University Agriculture Faculty Research Application Farm, **PSF**: Polatli State Farm, **TS**: Total score, **S**: Stature, **DC**: Dairy character, **BD**: Body depth, **CW**: Chest width, **RW:** Rump width, **RA:** Rump angle, **FD**: Food diagonal, **RLA**: Rear leg angle**, KS**: Knee structure, **RLS**: Rear leg set, **FUA**: Fore udder attachment, **RUH**: Rear udder height, **CL**: Central ligament, **UD**: Udder depth, **FUTP**: Fore udder teat placement, **FUTL:** Fore udder teat length, **RUTP**: Rear udder teat placement, **DT**: Dairy type, **BS**: Body structure, **FLS:** Food-leg structure, **US**: Udder structure

Table 4 The Correlations Between Linear Type Traits and General Traits at AUF

Traits	S	DC	BD	CW	RW	RA	RLA	FD	KS	RLS	FUA	RUH	CL	UD	FUTP	ÖMBU	RUTP	DT	BS	FLS	US
S																					
DC	0.36*																				
BD	0.22	-0.02																			
CW	0.10	-0.05	0.23																		
RW	-0.06	-0.23	0.16	0.19																	
RA	0.10	0.06	-0.03	-0.15	-0.07																
RLA	0.11	-0.01	-0.08	0.168	0.14	0.09															
FD	0.05	0.09	0.19	0.00	-0.02	0.17	0.15														
KS	0.33	0.01	-0.18	-0.16	-0.30*	0.18	-0.02	0.11													
RLS	-0.10	0.08	0.23	-0.02	-0.14	-0.21	-0.18	0.04	0.13												
FUA	0.07	-0.11	0.01	0.35*	0.004	-0.14	-0.07	-0.09	0.29*	-0.002											
RUH	0.16	-0.13	0.009	-0.16	-0.06	0.31*	0.06	0.12	0.02	-0.34*	-0.05										
CL	0.07	0.14	0.34*	0.22	-0.18	-0.10	-0.13	-0.17	0.14	0.13	0.20	0.06									
UD	-0.07	0.02	-0.11	0.24	0.07	-0.17	-0.08	-0.12	0.08	0.03	0.77**	-0.17	0.11								
FUTP	0.18	-0.007	0.10	0.33*	0.19	-0.18	0.29*	0.20	0.13	0.12	0.37**	0.05	0.19	0.39**							
ÖMBU	0.14	-0.14	0.009	-0.18	-0.05	0.14	0.21	0.15	0.04	-0.05	-0.01	0.22	0.30*	-0.15	-0.01						
RUTP	0.28	0.29*	0.19	0.11	-0.07	0.13	0.04	0.02	0.21	0.01	0.24	0.32*	0.70**	0.16	0.43	-0.10					
DT	0.51**	0.84**	-0.08	-0.005	-0.21	0.15	-0.07	0.11	0.03	-0.05	-0.05	0.47	0.13	0.02	0.09	-0.17	0.30*				
BS	0.49**	-0.04	0.38**	0.28	0.20	0.22	0.20	0.14	-0.12	-0.11	-0.03	0.44**	-0.07	-0.23	0.22	0.22	0.04	0.16			
FLS	0.29*	0.15	0.15	-0.10	-0.23	-0.05	0.01	0.22	0.30*	0.50**	-0.006	0.17	0.03	-0.24	0.19	0.18	0.09	0.23	0.38**		
US	0.45**	0.06	0.002	-0.03	-0.08	0.17	0.16	-0.05	0.22	-0.10	0.34*	0.47**	0.35*	0.20	0.41**	0.18	0.57**	0.24	0.35*	0.37**	
TS	0.62**	0.31*	0.14*	0.04	-0.09	0.15	0.05	0.08	0.19	0.08	0.19	0.39*	0.23	0.01	0.34*	0.12	0.41*	0.52**	0.60*	0.69*	0.81*

*: p<0.05, ** p<0.01, **AUÇ**: Ankara Üniversitesi Ziraat Fakültesi Araştırma Uygulama Çiftliği**, SY**: Sağrı yüksekliği, **SK**: Süt karakteri, **BD**: Beden derinliği, **ÖGG**: Ön göğüs genişliği, **SG**: Sağrı genişliği, **SE:** *: p<0.05, ** p<0.001, **AUF:** Ankara University Agriculture Faculty Research Application Farm, **PSF**: Polatli State Farm, **TS**: Total score, **S**: Stature, **DC**: Dairy character, **BD**: Body depth, **CW**: Chest width, **RW:** Rump width, **RA:** Rump angle, **FD**: Food diagonal, **RLA**: Rear leg angle**, KS**: Knee structure, **RLS**: Rear leg set, **FUA**: Fore udder attachment, **RUH**: Rear udder height, **CL**: Central ligament, **UD**: Udder depth, **FUTP**: Fore udder teat placement, **FUTL:** Fore udder teat length, **RUTP**: Rear udder teat placement, **DT**: Dairy type, **BS**: Body structure, **FLS:** Food-leg structure, **US**: Udder structure

Table 5 The correlations Between Linear Type Traits and General Traits at PSF.

Özelli k	S	DC	BD	CW	RW	RA	RLA	FD	KS	RLS	FUA	RUH	CL	UD	FUTP	ÖMBU	RUTP	DT	BS	FLS	US
S																					
DC	-0.03																				
BD	0.30**	-0.06																			
CW	-0.01	-0.25**	0.19**																		
RW	0.19**	-0.17**	0.03	0.05																	
RA	0.32**	0.008	-0.03	-0.08	0.17**																
RLA	0.04	-0.007	-0.005	0.09	0.31**	0.04															
FD	-0.005	-0.17**	0.12	0.07	0.04	-0.01	-0.02														
KS	-0.02	0.23**	-0.02	-0.15*	-0.03	0.04	-0.12	0.04													
RLS	-0.10	0.02	-0.11	-0.002	-0.05	-0.06	-0.17**	0.01	0.10												
FUA	-0.12*	-0.16*	-0.25**	-0.03	0.14*	-0.13*	0.16**	-0.02	-0.01	0.04											
RUH	0.05	0.03	-0.06	-0.06	0.20**	0.02	0.13*	-0.08	-0.10	0.09	0.22**										
CL	-0.01	-0.03	-0.07	-0.05	0.04	-0.07	0.04	-0.06	0.08	0.12*	0.38**	-0.01									
UD	-0.06	-0.08	-0.33**	0.02	0.000	-0.07	0.15*	-0.08	-0.03	0.08	0.76**	0.17**	0.38**								
FUTP	-0.01	0.06	0.02	-0.05	-0.14*	-0.15*	-0.05	-0.03	-0.01	0.03	0.19**	-0.04	0.17**	0.23**							
ÖMBU	0.001	0.02	0.09	0.14*	-0.18**	0.08	-0.07	0.001	0.08	0.03	-0.18**	-0.17**	-0.18**	-0.12	0.09						
RUTP	-0.02	0.009	0.03	-0.02	-0.04	-0.09	0.07	-0.05	0.009	0.03	0.34**	0.01	0.69**	0.36**	0.36**	-0.20**					
DT	-0.003	0.93**	-0.02	-0.22**	-0.08	0.02	0.05	0.15*	0.24*	-0.01	-0.11	0.05	0.02	-0.07	0.06	0.006	0.02				
BS	0.25"	-0.01	0.14*	0.10	0.30**	0.63**	0.11	0.08	-0.08	-0.02	0.00	0.12	0.003	-0.05	-0.07	0.09	-0.01	0.03			
FLS	0.001	0.001	-0.08	-0.03	0.02	0.08	0.09	0.10	0.32*	0.42*	0.021	-0.004	0.06	0.05	-0.06	0.04	0.01	0.03	-0.01		
US	-0.07	-0.08	0.007	-0.04	0.08	-0.05	0.19**	0.01	-0.05	-0.01	0.47**	0.20**	0.31**	0.39**	0.24**	0.12	0.46**	-0.06	0.02	0.12	
TS	0.01	0.13**	0.07	-0.10	0.08	0.15*	0.15*	0.04	0.21*	0.13*	0.25**	0.19**	0.23**	0.20**	0.13*	0.13*	0.30	0.46**	0.29**	0.45**	0.68**

*: p<0.05, ** p<0.001, **AUF:** Ankara University Agriculture Faculty Research Application Farm, **PSF**: Polatli State Farm, **TS**: Total score, **S**: Stature, **DC**: Dairy character, **BD**: Body depth, **CW**: Chest width, **RW:** Rump width, **RA:** Rump angle, **FD**: Food diagonal, **RLA**: Rear leg angle**, KS**: Knee structure, **RLS**: Rear leg set, **FUA**: Fore udder attachment, **RUH**: Rear udder height, **CL**: Central ligament, **UD**: Udder depth, **FUTP**: Fore udder teat placement, **FUTL:** Fore udder teat length, **RUTP**: Rear udder teat placement, **DT**: Dairy type, **BS**: Body structure, **FLS:** Food-leg structure, **US**: Udder structure

The correlations were changed from -0,12 (between 305-day milk yield and central ligament) to 0,26 (between 305-day milk yield and stature) between 305-day milk yield and linear type traits and were found non-significant at AUF (P>0.05) (Table 3). The correlations were changed from -0,11 (between 305-day milk yield and fore udder attachment) to 0,26 (between 305-day milk yield and stature) and were found significant at PSF (P<0.01) (Table 3).

The highest correlations were found between FUA and UD at AUF and PSF, were estimated as 0,77 and 0,76, respectively, and was found significant (P<0.01). The lowest correlations were found -0,34 at AUF (between RUH and RLS), were found -0,33 at PSF (between UD and BD) (Table 4 and Table 5).

The correlations were found high among DT, B, FLS, US and TP and were found significant at AUF (P<0.01). The same results were found in PSF (P<0.01) (Table 4 and Table 5). These correlations indicate that an increase in 305-day milk yield could be achieved through selection on any of the conformation traits

The best regression equation estimating 305-day milk yield was determined by Stepwise Linear Regression Analysis. Dairy character, stature, dairy type, rump width, rear udder height and rear leg set were included for the most suitable model. Consequently, The most high R^2 value was found 18,95 % at AUF and 17,06 % at PSF.

Throughout the study period, as no animal from PSF were separated form the herd, we were unable to detect the remaining duration of the animals in the herd. In AUF because of slaughtering, manner of dying, and to be sold 12 head cows were remained out of the herd and to those of animals, the remaining duration in the herd was detected as 63.9 ± 7.14 months.

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