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Article

Effects of Type Traits on Milk Yield and Quality in Primiparous Holstein-Friesian and Red-Holstein Cows

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Simple Summary

The selection of cattle by their body conformation also known as type traits is of great importance especially in dairy cows. The current study assessed the effects of type traits and other environmental factors on milk yield and quality in primiparous Holstein-Friesian and Red-Holstein cows. For this purpose, 18 linear type traits and 5 non-linear type traits of 120 cows were determined and their level of significance ($P<0.01-0.05$) on milk yield and quality traits was analyzed. Using the general linear model variance analysis, none of the environmental factors showed any significant effects on milk yield traits. The calving season effect was found to be significantly affecting the number of somatic cell counts (SCC) while the breed significantly affected the non-fat dry matter content (NFD) ($P<0.05$). As for the relationship between type traits and milk yield and quality, the rump width (RW) and body condition score (BCS) affected the morning milk yield (MMY); the RW, the rear leg angle (RLA) and the dairy strength (DS) affected the average daily milk yield (ADMY); the RW, RLA, the hock structure (HS) and the fore udder attachment (FUA) affected the 305 days milk yield (305-dMY) and the fore teat length (FTL) affected the SCC. The correlations between type traits and milk yield and quality traits ranged from low to moderate.

Abstract

The aim of this study was to determine the effects of type on milk yield and quality in Holstein-Friesian (HF) and Red-Holstein (RH) cows. In this study, 120 primiparous cows constituted of 58 HF and 62 RH were used and 18 linear type traits and 5 non-linear type traits, milk yield and quality traits such as morning milk yield (MMY), average daily milk yield (ADMY), 305 days milk yield (305-dMY), fat content (FC), non-fat dry matter (NFD) and somatic cell counts (SCC) were determined and their overall means were 13.01 ± 0.21 kg, 26.54 ± 0.81 kg, 8350.02 ± 282.97 kg, $3.24\pm0.02\%$, $9.78\pm0.05\%$ and 5.26 ± 0.02 (181,970 cells/ml), respectively. As for type traits, milk yield and quality, after a stepwise regression analysis, the prominent type traits were rump width (RW) and body condition score (BCS) for MMY; RW, rear leg angle (RLA) and dairy strength (DS) for ADMY; RW, RLA, hock structure (HS) and fore udder attachment (FUA) for 305-dMY; and the fore teat length (FTL) for SCC. The MMY showed weak correlations with type traits. The correlations of ADMY with the type traits varied between -0.28 and 0.33. Only the RW positively correlated with the 305-dMY ($r = 0.31$). The FC significantly positively correlated with the body depth (BD) with $r = 0.20$. The result of this study suggests that RW and optimal BCS should be prioritized in selection of HF and RH cows. Furthermore, due to its strong association with SCC, the FTL is a prominent trait for improving udder health and reducing the prevalence of mastitis in dairy cattle.

Keywords: prominent type traits; somatic cell count; primiparous cows; milk quality

1. Introduction

The milk production sector constitutes a significant contributor to global economy by increasing the income of farmers and countries as well. Even though milk is produced by so many other animal species such as buffalo, goats, sheep, camel, etc, more than 80% of produced and consumed milk is bovine milk [1]. Generally, milk production is affected by a great number of factors such as breed, nutrition, barn type, management, milking system, season, parity, lactation period, lactation stage, climate, diseases occurrence, etc. In order to maximize milk production, farmers must play on those previously cited factors by increasing the cattle comfort and by attenuating their threats to the cow. The farmer must also focus on the genotype of the cow and practise selection on both high production performances with good health and economically beneficial in terms of feed intake. One of the ways to practise a selection based on the above traits is the use of body conformation traits or type traits.

The type traits are defined as physical characteristics of dairy cows and are related to their productivity, longevity, overall health and are often evaluated in dairy cattle breeding programs to improve cattle efficiency and profitability of milk production [2]. While the selection of breeding animals based on external appearance (coat color, horniness, body size, etc) is the oldest feature [3], the production level was considered as auxiliary criteria and such external features were prioritized till the mid 1900's [4]. In addition to genetic features, the type traits also constitute the selection tool for reproduction [5], longevity, milk production and culling reasons [6], prediction of body weight [7,8], fertility [9–11], profitability, udder health, milk components and milk somatic cells [12,13], health features [9,14,15] and greater longevity [16] in dairy cows. The type traits are also used to grade the bulls using the type traits of their daughters [17,18]. The failure of type traits' based selection leads to a low production and poor health issues, facts that result in early culling of the animals from the herd [19,20].

In previous studies, researchers have reported significant relationship between bovine type traits and milk yield and quality especially most of the udder traits [21,22], as high scores of some physical traits may indicate the cow's ability to withstand high milk production and good quality milk products. [23] reported the significant udder and teat shapes' effects on subclinical mastitis prevalence in dairy cows. Similarly, [15] also reported the significant effects of udder and teat traits on somatic cell counts (SCC) and concluded that the improved milk quality and less SCC should be reached by practicing selection based on udder and teat traits. [24] also mentioned a positive correlation of milk yield with conformation traits while [25] reported a negative correlation between the rear udder height and milk SCC. In their study, [26] found the stature to be significantly positively correlating with milk yield. For a suitable selection, [27] advised the use of both production and conformation traits especially for genetic selection. The type traits were said to vary within the time. In a study, there was a tendency of many of the studied traits to increase or decrease in terms of genetic merit in a period of study of 20 years [28]. The selection based on type traits should be prioritized in modern cattle farming.

There are different methods to score the type traits. [29] used the scoring scale of 1-50 scores. The International Committee for Animal Recording [30] used a scoring scale of 1-9 scores and this method has been taken as reference and it is nowadays used by so many researchers, especially in scoring the linear type traits and it was also used in this study. The other used scoring method is the non-linear method using 65-100 scores. In this non-linear method, a cow is analyzed and the body parts are attributed a subjective score, depending on the accuracy of the classifier and the classifier effect must be included in the statistical model when more than one classifier performed the scoring. In most of the studies, the 100-points scoring method is always used together with the linear method.

This study was aimed to determine the effects of type traits on milk yield and quality in primiparous Holstein-Friesian and Red-Holstein cows.

2. Materials and Methods

The farm used in this study was located in Cincin village, Koçarlı county of Aydın province in the Republic of Türkiye. A total of newly imported 120 heads pregnant heifers from Germany in 2023 and quarantined in Hungary, composed of 58 HF and 62 RH was used. For the linear method, 1-9 scores were determined and the Stature (ST), chest width (CW), body depth (BD), rump angle (RA), rump width (RW), body condition score (BCS), rear legs set angle (RLA), rear legs rear view (RLV), foot angle (FA), hock structure (HS), fore udder attachment (FUA), rear udder width (RUW), rear udder height (RUH), central ligament (CL), udder depth (UD), fore teat length (FTL), rear teat placement (RTP) and mammary acuity (MA) were scored. As for the non-linear method, cows' scores out of 100 were determined by scoring the dairy strength (DS), frame, feet and legs (FL), udder and total score (TS). Only the physically healthy cows with the lactation period between 30 and 150 days were scored. Milk samples from the cows were taken during the morning milking from November 2023 to January 2025, and analyzed in the Laboratory of Animal Science, Faculty of Agriculture, Aydın Adnan Menderes University, Türkiye. The evaluation of the type traits of the cows were started in December, 2023 and completed in July 2024. In order to determine the effects of type traits on milk yield and quality, the determined milk yield traits were the lactation average morning milk yield (MMY), average daily milk yield (ADMY) and the 305 days milk yield (305-dMY). The determined milk quality traits were the milk fat content (FC) using the Gerber method [31]; non-fat dry matter (NFD) using a portable refractometer, Brand: ATC Refractometer 0-32% BRIX, and the SCC using the Direct Microscopic Somatic Cell Count method [32]. The 305-dMY and ADMY data of HF and RH cows were taken from the herd management system of the farm. The lactation averages for MMY, milk components (FC and NFD) and Log₁₀SCC were calculated by using the data of each animal after analyzing the milk samples taken monthly.

2.1. Statistical Analysis

In this study, the stepwise regression analysis method was used to include the effects of type traits on milk yield and quality traits in the statistical analysis model using [33] package tool. Then, instead of all type traits, the type traits that highly correlated with the traits emphasized as a result of the stepwise regression analysis were included in the model and then the statistical analysis was performed. According to the results of stepwise regression analysis, the significant type traits on different milk yield traits were the RW, RLA, FUA and HS for 305-dMY; the RW, RLA and DS for ADMY; the BCS and RW traits for the MMY. As for milk quality, only the SCC was considered for the analysis and as a result of the stepwise regression analysis, only FTL stood out for this quality traits. In order to facilitate the analysis, the SCC were transformed into 10 based logarithm (Log₁₀SCC).

2.1.1. Statistical Model for MMY Analysis

The statistical model (1) was used to analyse the significance of the traits on MMY.

$$Y_{ijkl} = \mu + a_i + b_j + c_k + d(M_{ijkl} - \bar{M}) + g(X_{ijkl} - \bar{X}) + e_{ijkl} \quad (1)$$

where: y_{ijkl} : observation value of the MMY; μ : estimated mean value of the MMY; a_i : breed effect (i = HF, RH); b_j : calving season effect (j = 1: winter-spring, 2: summer, 3: autumn), c_k : first calving age group effect (k = 1 (<25 mo), 2 (25-27 mo), 3 (>27 mo)); d : regression coefficient of RW on MMY; $\bar{M}$: average of RW; M_{ijkl} : observation value of RW; f : regression coefficient of BCS on MMY; $\bar{X}$: average of BCS; X_{ijkl} : observation value of BCS; e_{ijkl} : represents the error term.

2.1.2. Statistical Model for ADMY Analysis

The statistical model (2) was used to analyse the significance of the traits on ADMY.

$$Y_{ijkl} = \mu + a_i + b_j + c_k + d(M_{ijkl} - \bar{M}) + f(N_{ijkl} - \bar{N}) + g(X_{ijkl} - \bar{X}) + e_{ijkl} \quad (2)$$

where: y_{ijkl} : observation value of the ADMY; μ : estimated mean value of the ADMY; a_i : breed effect ($i = \text{HF, RH}$); b_j : calving season effect ($j = 1$: winter-spring, 2 : summer, 3 : autumn), c_k : first calving age group effect ($k = 1$ (<25 mo), 2 ($25\text{-}27$ mo), 3 (<27 mo)); d : regression coefficient of RW; $\bar{M}$: average of RW; M_{ijkl} : observation value of the RW; f : regression coefficient of RLA; $\bar{N}$: average of RLA; N_{ijkl} : observation value of the RLA; g : regression coefficient of DS; $\bar{X}$: average of DS; X_{ijkl} : observation value of the DS; e_{ijkl} : represents the error term.

2.1.3. Statistical Model for 305-dMY Analysis

The statistical model (3) was used to analyse the significance of the traits on 305-dMY.

$$Y_{ijkl} = \mu + a_i + b_j + c_k + d(M_{ijkl} - \bar{M}) + f(N_{ijkl} - \bar{N}) + g(X_{ijkl} - \bar{X}) + h(Z_{ijkl} - \bar{Z}) + e_{ijkl} \tag{3}$$

where: y_{ijkl} : observation value of 305-dMY; μ : estimated mean value of the 305-dMY; a_i : breed effect ($i = \text{HF, RH}$); b_j : calving season effect ($j = 1$: winter-spring, 2 : summer, 3 : autumn), c_k : first calving age group effect ($k = 1$ (<25 mo), 2 ($25\text{-}27$ mo), 3 (<27 mo)); d : regression coefficient of RW; $\bar{M}$: average of RW; M_{ijkl} : observation value of the RW; f : regression coefficient of RLA; $\bar{N}$: average of RLA; N_{ijkl} : observation value of the RLA; g : regression coefficient of HS; $\bar{X}$: average of HS; X_{ijkl} : observation value of the HS; h : regression coefficient of FUA; $\bar{Z}$: average of FUA; Z_{ijkl} : observation value of the FUA; e_{ijkl} : represents the error term.

2.1.4. Statistical Model for Lactation Average FC and NFDM Analysis

The statistical model (4) was used to analyse the significance of the traits on FC and NFDM.

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl} \tag{4}$$

where: y_{ijkl} : observation value of the traits; μ : estimated mean value of the traits; a_i : breed effect ($i = \text{HF, RH}$); b_j : calving season effect ($j = 1$: winter-spring, 2 : summer, 3 : autumn), c_k : first calving age group effect ($k = 1$ (<25 mo), 2 ($25\text{-}27$ mo), 3 (<27 mo)); e_{ijkl} : represents the error term.

2.1.5. Statistical Model for Log₁₀SCC Analysis

The statistical model (5) was used to analyse the significance of the traits on Log₁₀SCC.

$$Y_{ijkl} = \mu + a_i + b_j + c_k + d(M_{ijkl} - \bar{M}) + e_{ijkl} \tag{5}$$

where: y_{ijkl} : observation value of the Log₁₀SCC; μ : estimated mean value of the Log₁₀SCC; a_i : breed effect ($i = \text{HF, RH}$); b_j : calving season effect ($j = 1$: winter-spring, 2 : summer, 3 : autumn), c_k : first calving age group effect ($k = 1$ (<25 mo), 2 ($25\text{-}27$ mo), 3 (<27 mo)); d : regression coefficient of FTL; $\bar{M}$: average of FTL; M_{ijkl} : observation value of the FTL; e_{ijkl} : represents the error term.

3. Results and Discussion

3.1. Effects of Type Traits on Milk Yield and Quality

In this study, in addition to the stepwise regression analysis of the significance of the type traits on milk yield and quality, other environmental effects such as breed, calving season (CalSeason) and first calving age group (FCAgr) were also analyzed.

3.1.1. Effects of Type Traits on Milk Yield

The least square means (LSM) and standard errors (SE) of MMY, ADMY and the 305-dMY were presented in Table 1 and were calculated to be 13.01 ± 0.21 kg, 26.54 ± 0.81 kg and 8350.02 ± 282.97 kg, respectively. All environmental factors on milk yield such as the breed, CalSeason and the FCAgr effects were not found important ($P > 0.05$).

Table 1. Least Square Means and Std. Error of morning milk yield (MMY), average daily milk yield (ADMY) and 305 days milk yield (305-dMY) of primiparous Holstein-Friesian (HF) and Red-Holstein (RH) cows.

Factor	N	MMY, kg $\bar{X} \pm S_{\bar{X}}$	ADMY, kg $\bar{X} \pm S_{\bar{X}}$	n	305d-MY, kg $\bar{X} \pm S_{\bar{X}}$
Breed		NS	NS		NS
1 (HF)	58	13.32±0.32	25.82±1.29	52	8063.60±397.46
2 (RH)	62	12.70±0.41	27.25±1.62	61	8636.44±511.48
CalSeason		NS	NS		NS
1	71	13.20±0.33	29.39±1.30	69	9058.37±413.32
2	27	12.92±0.51	25.43±2.08	24	7821.29±699.83
3	22	12.92±0.49	24.79±1.94	20	8170.40±608.68
FCAgrp		NS	NS		NS
1	28	13.28±0.43	27.31±1.73	27	8130.41±532.29
2	46	12.87±0.35	27.44±1.40	42	8944.39±443.05
3	46	12.89±0.42	24.86±1.66	44	7975.26±525.12
RW	120	*-0.41±0.26	**3.58±1.03	113	**881.64±314.17
RLA	120	-	** -1.76±0.76	113	** -608.87±234.37
HS	120	-	-	113	*206.74±292.66
FUA	120	-	-	113	*364.55±264.10
DS	120	-	*-0.86±0.46	-	-
BCS	120	*-0.37±0.22	-	-	-
Overall	120	13.01±0.21	26.54±0.81	113	8350.02±282.97

NS: Not significant; **: P<0.01; *: P<0.05; **RW**: rump width; **RLA**: rear leg set angle; **HS**: hock structure; **FUA**: fore udder attachment; **DS**: dairy strength; **BCS**: body condition score.

Regarding the MMY (Table 1), as a result of stepwise regression analysis, the RW and BCS traits were identified as prominent traits. Considering the significant RW, the width of the rump in dairy cows plays a great role especially during parturition. When the rump is narrow, the cows undergo dystocia, fact that can result in very costly surgery issues such as caesarean operation. When the rump is wide, which is ideal, there is calving ease. The surgical operation that is likely to occur in case of narrow rumps can cause high level of stress in cows and time of recovery and use of antibiotics that make the yielded milk unsuitable for consumption and thus the decrease of milk yield in lactating cows. At the same time, the wide rump corresponds to the wider udder, and therefore, this increases the milk secretion capacity of the udder and the milk yield is increased. Despite the negative regression coefficient (b = -0.41±0.26) found between the MMY and the RW, the ideal rump in dairy cows should be enough wide for calving ease.

As for the BCS, it is also likely to affect milk productivity. For both production and reproduction, there are scores that the cows might have for better results. In scoring method using 1-5 scale, the lactating cows should have between 2.5 and 3.5 scores [34]. As for the 1-9 scoring scale, lactating cows should be between 5 and 6 scores [2]. Cows having lowers scores are not suitable for production because they miss body reserves that are enough for production and reproduction and there is a negative regression coefficient of the BCS on MMY (b = -0.37±0.22). Cows having higher scores are

considered as fat and hormonal regulation is disturbed by body fats, thus the poor production and reproduction performances.

Regarding the ADMY, as a result of stepwise regression analysis, RW, RLA and DS were prominently associated traits. As for the RW, the details and consequences are similar for MMY and there was a positive regression coefficient ($b = 3.58 \pm 1.03$). This can be understood in the sense that the increase of 1 score of RW will cause the increase of 3.58 kg of milk daily. The RLA can be understood in walking capability of cows for reaching feed and water in the barn. Both straight and sickled legs are not desirable in dairy cows due to the walking difficulties that are likely to cause hoof lesions. The disease infections met in those lesions require antibiotics use in lactating cows and there could be huge losses in terms of daily milk yield. As far as the DS is concerned, its impact on milk yield is indispensable because it encompasses almost all the morphological features of dairy cows such as the roundness or sharpness of the withers, rib spacing, harmony of the body, skeletal structure and neck length. The failure in these structures leads to the failure of milk production. For both the RLA and the DS, there were negative regression coefficients ($b = -1.76 \pm 0.76$ and $b = -0.86 \pm 0.46$, respectively), which means that the increase of their scores both negatively affect the ADMY.

The effects of type traits on 305-dMY were also studied and resulted in RW and RLA, FUA and HS. The RW and RLA were discussed before on MMY and ADMY because the failure in MMY will affect the ADMY and thus the 305-dMY. Regarding the FUA, the connection between the udder and the abdomen of the cow is important in milk production synthesis in lactating cows. The connection of the udder to the body must be strong especially for disease resistance and milk yield. As for the HS, it plays a great role especially in the mobility and the comfort of the cows to access the feed and water. In case of uncomfot due to the bad hock structure, the cow is not able to access water and food as other animals in the herd and this results in milk yield loss thus the 305-dMY is reduced. Unless the RLA that had a negative regression coefficient ($b = -608.87 \pm 234.37$), these other type traits showed a positive influence on the 305-dMY with $b = 881.64 \pm 314.17$, $b = 206.74 \pm 292.66$ and $b = 364.55 \pm 264.10$ of regression coefficients respectively for RW, HS and FUA (Table 1).

3.1.2. Effects of Type Traits on Milk Quality

The milk quality traits analyzed in this study were the milk FC, NFDM and SCC. Since it was judged to be meaningless to examine the effects of type traits on FC and NFDM, only the effects of type traits on SCC were considered and after the stepwise regression analysis, only the FTL trait stood out. The LSM and SE of the FC, Log10SCC and NFDM contents were presented in Table 2 and their overall means were $3.24 \pm 0.02\%$, $9.78 \pm 0.05\%$ and 5.26 ± 0.02 (181,970 cells/ml), respectively. Among the studied effects, none of them showed significant effects on milk FC ($P > 0.05$). Here, the only recommendation to be given is that farmers should put great importance on animal feeding and suitable farm management in order to get good rates of milk fat contents. Only the breed effect on NFDM was found to be statistically significant ($P < 0.05$). As expected, the RH milk samples had higher milk NFDM when compared to the HF milk samples (Table 2).

Table 2. Least Square Means and Std. Error of fat content (FC), somatic cell count (Log10SCC) and non-fat dry matter (NFDM) contents of primiparous Holstein-Friesian (HF) and Red-Holstein (RH) cows.

Factor		FC, %	Log ₁₀ SCC	NFDM, %	
	n	$\bar{X} \pm S_{\bar{X}}$	$\bar{X} \pm S_{\bar{X}}$		$\bar{X} \pm S_{\bar{X}}$
Breed		NS	NS		*
1 (HF)	58	3.20 ± 0.03	5.25 ± 0.03	55	9.64 ± 0.08
2 (RH)	62	3.27 ± 0.04	5.27 ± 0.04	60	9.93 ± 0.10

CalSeason		NS	*	NS	
1	71	3.28±0.03	5.18±0.03 ^a	67	9.73±0.08
2	27	3.23±0.06	5.34±0.05 ^{bc}	26	9.88±0.12
3	22	3.19±0.05	5.27±0.04 ^{ac}	22	9.74±0.12
FCAgr		NS	NS	NS	
1	28	3.22±0.05	5.20±0.04	28	9.79±0.10
2	46	3.27±0.04	5.30±0.03	44	9.68±0.08
3	46	3.22±0.05	5.29±0.04	43	9.89±0.10
FTL		120	-	*-0,052±0,022	-
Overall	120	3.24±0.02	5.26±0.02	115	9.78±0.05

NS: Not significant; *: P<0.05. FTL: fore teat length; **a, b, c**: Differences between the groups with the same letter are not significant according to P<0.05.

As far as the SCC is concerned, in this study, the CalSeason and the FTL effects on Log10SCC were found to be statistically significant (P<0.05). Concerning the CalSeason, the averages in season 1 (winter and spring) were found lower when compared to those in season 2 (summer) but they were not significantly different from those in season 3 (autumn).

For the FTL, as the teats constitute the entrance gate to the udder by connecting it to the exterior environment, thus, the teat length plays a great role on the health of the cow’s udder. The shorter teats with a score less than 4 and the longer teats with a score more than 6 are not ideal [2] especially in machine milked cows.

Also, in this study, there was a slightly negative regression coefficient of the FTL on the milk SCC (b = -0,052±0,022), which means that an increase of 1 score of FTL with cause a slight decrease of 0.052 Log10SCC, fact which is good in terms of milk quality.

3.2. Correlations

Correlations of Type Traits with Milk Yield and Quality

In this study, the relationships between type traits and MMY, ADMY, 305-dMY, FC, NFDm and SCC were determined using Pearson correlation. As it can be seen in Table 3, the correlation coefficients of type traits with MMY were very low, including the negative and positive ones and were calculated to range between r = -0.17 and r = 0.12 and none of them was reported to be statistically significant (P>0.05). Both the RW and BCS, highlighted by stepwise regression analysis, were here found to negatively correlate with the MMY and their correlation coefficient was found to be r = -0.17 (P>0.05).

As for the ADMY, the correlation coefficients varied from low to moderate and there were negative and positive ones, all ranging between r = -0.28 for RLA and 0.33 for RW. The RW (r = 0.33; P<0.01), RLA (r = -0.28; P<0.01), HS (r = -0.25; P<0.01) and DS (r = -0.19; P<0.05) were found and only the RW positively correlated with the ADMY. Other coefficients were lower whether being negative or positive, with some equaling or almost equaling to zero.

The 305-dMY being dependent on the ADMY, the significant correlation coefficients were similar and were RW (r = 0.31; P<0.01), RLA (r = -0.34; P<0.01), HS (r = -0.22; P<0.01) and DS (r = -0.20; P<0.05). The RW was the only one positively correlating with the 305-dMY. For milk quality, only the milk FC was found to significantly positively correlate with the BD and the correlation coefficient was found to be r = 0.20 (P<0.05), other significant correlations were negative such as the FA with FC (r = -0.20; P<0.05), the FA with NFDm (r = -0.23; P<0.05) and the FTL with SCC (r = -0.21; P<0.05).

By comparing the current results with those in other studies, [8] calculated the correlation coefficients of type traits with milk yield traits and were found to range between 0.08 and 0.69, which

were greater than those found in this study. [35] calculated the correlation of type traits with milk yield and all the found coefficients were less than 0.30 and concluded that the type traits should not be considered as good predictors of milk yield in dairy cows. In another study of determining the relationship between type traits and milk yield, the ST, CW, RA, RLV, RUH and FUA were found to positively correlate with whole lactation milk yield and the correlation coefficients were reported to range between 0.09 and 0.39 [26]. In all studies realized about this subject, the study of [26] was the one whose results were a bit similar to the current findings even though the found correlation coefficients were a little different.

Ref. [36] found the correlation of type traits with milk yield to range between -0.90 and 0.96. [37] also determined the relationship between milk yield and 18 linear type traits and the correlations were ranging between -0.33 and 0.71. In a study by [24], the averages of 305-dMY in HF cows were calculated to range between 4862 and 7847 kg and these values positively correlated with type traits. By analysing the results of their study, [35] concluded that the linear type traits should not be considered as good predictors of milk yield. In a study by [27], only the udder texture and the angularity were found to positively correlate with the milk yield and quality traits in the studied herd. [11] found a strong correlation between some body traits and milk yield and the high producing cows were found with less desirable udder traits. A significant effect of BCS on daily milk yield was reported in a study by [38].

Table 3. Pearson correlation coefficients calculated between type traits and milk yield and quality in primiparous Holstein-Friesian (HF) and Red-Holstein (RH) cows.

Trait	MMY n=120	ADMY n=120	305-dMY n=113	FC n=120	NFDM n=115	Log ₁₀ SCC n=120	FCA n=120
ST	-0.14	0.15	0.08	-0.07	0.01	-0.07	0.03
CW	-0.10	-0.11	-0.14	-0.05	-0.16	-0.13	0.09
BD	-0.05	-0.07	-0.03	0.20*	-0.11	-0.03	-0.04
RA	-0.06	0.12	0.09	0.03	-0.01	0.04	0.20*
RW	-0.17	0.33**	0.31**	0.04	0.11	0.04	0.16
BCS	-0.17	0.06	-0.04	0.07	-0.02	0.00	-0.05
RLV	0.10	-0.15	-0.12	0.03	0.03	0.02	-0.16
RLA	-0.05	-0.28**	-0.34**	-0.08	-0.04	0.12	-0.27**
HS	-0.06	-0.25**	-0.22*	-0.09	-0.03	-0.01	-0.11
FA	-0.13	-0.02	0.04	-0.20*	-0.23*	-0.03	-0.18*
FUA	-0.16	0.08	0.07	0.03	0.02	-0.12	0.02
RUW	0.10	-0.01	-0.01	0.12	0.02	0.09	-0.04
RUH	0.10	-0.14	-0.13	-0.06	0.06	0.06	-0.27**
CL	0.08	0.04	-0.02	0.05	-0.06	-0.09	-0.04
UD	-0.01	0.00	-0.01	-0.03	0.04	0.04	-0.11
RTP	-0.07	0.10	0.06	0.12	-0.06	-0.15	0.01
FTL	0.04	-0.01	-0.07	0.02	-0.03	-0.21*	-0.11
MA	-0.06	0.00	0.04	0.04	0.01	-0.03	-0.04
DS	0.12	-0.19*	-0.20*	-0.13	-0.14	0.11	-0.06
Frame	-0.17	0.07	0.06	0.01	-0.05	0.00	0.17
FL	-0.02	-0.11	-0.07	-0.06	-0.10	-0.03	-0.21*
Udder	-0.06	-0.01	-0.06	0.09	0.02	-0.04	0.00
TS100	-0.06	-0.10	-0.12	-0.03	-0.11	0.01	-0.04

**₂: P<0.01; *₂: P<0.05; ST: stature; CW: chest width; BD: body depth; RA: rump angle; RW: rump width; BCS: body condition score; RLV: rear leg rear view; RLA: rear leg set angle; HS: hock structure; FA: foot angle; FUA: fore udder attachment; RUW: rear udder width; RUH: rear udder height; CL: central ligament; UD: udder depth; FTL: Fore teat length; RTP: rear teat placement; MA: mammary acuity; DS: dairy strength; FL: feet and legs; TS100: total score out of 100.

As it was proposed by [11] to use a limited number of type traits where he proposed stature for milk yield and udder support for milk quality, it is similar to the current findings and it can be proposed here to use the RW during the selection for milk yield in dairy cows, especially in HF and RH used in this study. In order to know if it is similar even in other cattle breeds, the study should be extended to other breeds.

4. Conclusions

This study stated the importance of using type traits to predict milk yield and milk quality in primiparous HF and RH lactating cows. Regarding the relationship between the type traits and milk yield and quality, RW was the most consistent and positive predictor across all milk yield traits (MMY, ADMY and 305-dMY). For milk quality, FTL was the only type trait significantly affecting SCC. These findings can lead to the conclusion that type traits should be mostly used during selection for milk production and quality of dairy cattle but by using a limited number of significant traits, as it was also proposed by other researchers mentioned in this study. The results of this study indicate that selection programs for HF and RH cows should prioritize RW and optimal BCS to increase milk production potential. Furthermore, due to its strong relation with SCC, FTL should be prioritized to improve udder health and reduce the prevalence of mastitis in dairy herds. To fully assess the long-term predictive value of these type traits on sustainable production and herd longevity, future longitudinal studies following these animals through subsequent parities are essential.

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