Turkish Journal of Agriculture - Food Science and Technology, 12(s4): 2783-2788, 2024
DOI: https://doi.org/10.24925/turjaf.v12is4.2783-2788.7219

Turkish Journal of Agriculture - Food Science and Technology

Available online, ISSN: 2148-127X | www.agrifoodscience.com | Turkish Science and Technology Publishing (TURSTEP)

Type Traits of Primiparous Holstein-Friesian and Red-Holstein Cows Raised Together in a Farm in Aydın Province

Frederic Ndihokubwayo[1,2*], Atakan Koç[2]

[1]Burundi Institute of Agricultural Sciences, Rohero 1, Avenue de la Cathedrale, B.P. 795, Bujumbura, Burundi
[2]Aydın Adnan Menderes University, Garduate School of Natural and Applied Sciences, Department of Animal Science, 09100, Aydın, Türkiye
[*]Corresponding author

A R T I C L E I N F O

Research Article

Received : 15.10.2024
Accepted : 22.11.2024

Keywords:
Dairy cattle
Linear type traits
Body condition score
Udder depth
Mammary acuity

A B S T R A C T

The aim of this study was to compare the type traits of primiparous Holstein-Friesian (HF) and Red-Holstein (RH) cows reared mixed in a private farm in Aydın province, Türkiye. In this study, 120 heads composed of HF and RH primiparous cows were used and the effects of breed, calving year (2023, 2024) and calving age (<26 mo and ≥26 mo) on type traits were also investigated. Five non-linear 100 score traits and 18 linear type traits were measured. The effect of breed on chest width (P<0.01), body condition score (P<0.01), rear legs set angle (P<0.01), hock structure (P<0.05), rear udder width (P<0.01), udder depth (P<0.01), central ligament (P<0.05), rear udder height (P<0.01), fore teat length (P<0.05) and mammary acuity (P<0.01) were found statistically significant and the overall mean scores for these traits were 5.32±0.13, 6.97±0.17, 4.83±0.09, 4.87±0.08, 5.04±0.09, 5.74±0.09, 4.73±0.04, 5.37±0.08, 8.35±0.08, 5.38±0.08 and 7.32±0.17, respectively. Also, the effect of calving year on body depth (P<0.01), udder depth (P<0.05) and rear teat placement (P<0.05) and the effect of calving age on chest width (P<0.05), rear legs set angle (P<0.05) and rear teat placement (P<0.05) were found statistically significant. For non-linear 100 scores, the breed effects on dairy strength (P<0.01), foot & legs (P<0.05), udder (P<0.01) and total score (P<0.01) were significant and the means were 82.30±0.17, 81.63±0.11, 83.98±0.09 and 83.03±0.07, respectively. As a result, the significant breed effect found in some type traits showed that HF and RH genotypes, which differ only in color genes, have been considered and reared as different breeds since the 1950's, causing significant differences in some type traits of these two genotypes.

[a] ndihokubwayofrederic2017@gmail.com https://orcid.org/0000-0003-4491-4464 | [b] akoc@adu.edu.tr https://orcid.org/0000-0001-5324-4154

Introduction

The priority criteria given to the selection methods by farmers have been changing within the time. Before, breeding cattle were selected according to their coat colour, horniness, body size, etc, and such features were used until the mid 1900's when they began to focus on productivity criteria (Künzi, 1994). Later on, those old selection practices have been replaced by a type of selection based on measurable characteristics of the animal's body called type traits. Type traits are then referred to as specific characteristics used to measure the body conformation of the animal by scoring its physical appearance, structure and functional abilities. The type traits are also used in breeding programs for the selection of healthier and more productive cows, that are able to withstand a high production. The type traits constitute the measurable external appearance that are generally transferred to the offspring and their heritability indexes have already been calculated. With the existence and using of type traits as a selection tool, cows are no longer evaluated as good or bad according to the targeted trait, but most of the body parts are measured and scored and this method is also used to grade the bulls according to the traits of their daughters (Boettcher et al., 1997; Güler et al., 2020). In dairy cows, the type traits can be taken as predictors of reproduction (Schneider et al., 2003), milk production, longevity and culling of the cows (Zavadilová & Štípková, 2012), body weight (Veerkamp & Brotherstone, 1997; Berry et al., 2004), health (Rogers et al., 1991; Pryce et al., 1998; Juozaitiene et al., 2006) and fertility (Pryce et al., 1998; Royal et al., 2002; Harris, 2015). The type traits have also a relationship with profitability, herd life, udder health, milk components and milk somatic cell count (Gengler et al., 1997; Rogers et al., 1998).

Historically, the evaluation of cattle based on type traits was thought for the first time in 1976 and the first linear traits were implemented in 1979 (Vinson et al., 1982; Lucas et al., 1984). In 1983, the Holstein Association began to use the type traits in evaluating cows and the basic standard for Holstein cows was installed in the year 1997. In Türkiye, a group of 10 classifiers was trained in 1995 and the proper conformation recording was installed in 1999 and the results were published in the year 2000 by the

Ministry of Agriculture and Forestry (Şahin, 2011). There are various scoring methods that have been developed especially for dairy cows. Funk & Hansen (1991) used 1 to 50 scores. The International Conformation Recording Association (ICAR) developed a linear scoring method utilizing 1 to 9 scores and this method has been taken as scoring standard for linear type traits and was utilized in this study. ICAR also developed a non-linear method using 100 scores that is subjective and the score depends mostly on the precision of the classifier (ICAR, 2018) and this method was also used in this study. In type traits scoring, three composites are taken into consideration such as body, feet and legs and udder composites. The ideal for dairy cows is that their body must be strong, with a good stature, wide rump and enough depth of the body. The legs' structure must also be suitable and strong enough to support the entire body and the udder must have a high capacity to transform and produce more milk. The udder must also be at a suitable height and depth to avoid being vulnerable to mastitis. In most of the studies, body composite traits were not given importance in most of the studied effects (Wesseldijk, 2004; Ndihokubwayo & Koç, 2024) but feet and legs traits were given a little emphasis while great importance was given to udder traits, which directly gained a great use as a selection tool in most breeding schemes (Wesseldijk, 2004).

The aims of this study were to compare the type traits of primiparous Red-Holstein (RH) cattle, which have attracted the attention of Turkish breeders in recent years, and primiparous Holstein-Friesian (HF) cattle raised together in a dairy cattle farm, as well as to determine the effect of some environmental factors on these traits.

Materials and Methods

Classifier, Animal and Farm Materials

In this study, a total of 120 heads composed of mixed HF (n=58) and RH (n=62) cows reared in a private farm was used. The farm is located in Cincin village of Koçarlı county, Aydın province of Türkiye. All of the animals used in this study were imported from Hungary in 2023 as gestant heifers and all were in their first lactation. The cows were born in 2021 and 2022 in Hungary and started calving in 2023-2024 in Türkiye. The linear and non-linear scoring was processed after 2 hours from the milking time and only cows whose lactation period was between 30 and 150 days were scored. In addition, all the scores were processed by one expert and author who received a suitable training for trait recording.

Methods

Linear Type traits

In this study, 18 traits were assessed for linear type traits such as 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), hock structure (HS), foot angle (FA), fore udder attachment (FUA), rear udder height (RUH), rear udder width (RUW), central ligament (CL), udder depth (UD), fore teat length (FTL), rear teat placement (RTP) and mammary acuity (MA). The traits were scored using 1 to 9 scores as 1-3 for lower scores, 4-6 for intermediate scores and 7-9 for higher scores. According to the targeted trait, the lower and higher scores may not be preferred for a suitable selection and there is an ideal score for each trait. The detailed score limits and ideal scores are presented in Table 1.

Non-linear 100 scoring method

The 100 scoring method was also used to determine the overall score out of 100 for the dairy cows. This method is subjective and is based on: dairy strength (DS, 15%), frame (20%), foot and leg (FL, 25%) and udder (40%) all to form a total of 100 scores. ICAR (2018) established the variation of the scores as follows: 50-74: Fair/Poor/Insufficient, 75-79: Good, 80-84: Good plus, 85-89: Very good and 90-97: Excellent.

Table 1. Score limits and ideal scores for the linear type traits (ICAR, 2018)

Traits	Abbreviations	Scores			Ideal scores
		1-3	4-6	7-9	
Stature	(St)	Lower	Intermediate	Higher	9
Chest width	(CW)	Narrow	Intermediate	Wide	9
Body depth	(BD)	Shallow	Intermediate	Deep	7
Rump angle	(RA)	High pins	Intermediate	Low pins	5
Rump width	(RW)	Narrow pins	Intermediate	Wide pins	7
Body condition score	(BCS)	Thin	Intermediate	Fat	5-6
Rear legs set angle	(RLA)	Straight	Intermediate	Sickled	5
Hock structure	(HS)	Coarse	Intermediate	Fine & thin	9
Rear legs rear view	(RLV)	Toes out	Intermediate	Bow-legged	8
Foot angle	(FA)	Low	Intermediate	Steep	7
Fore udder attachment	(FUA)	Loose	Intermediate	Strong	9
Rear udder height	(RUH)	Low	Intermediate	High	9
Rear udder width	(RUW)	Narrow	Intermediate	Wide	9
Central ligament	(CL)	Weak	Intermediate	Strong	7-8
Udder depth	(UD)	Deep	Intermediate	High	6
Fore teat length	(FTL)	Short	Intermediate	Long	4
Rear teat placement	(RTP)	Wide	Intermediate	Close	7
Mammary acuity	(MA)	Defect	Intermediate	Perfect	9

Table 2. Least square means and standard errors of linear type traits scores.

Traits	Breed $\bar{X}+S_{\bar{x}}$		Calving Year $\bar{X}+S_{\bar{x}}$		First Calving Age $\bar{X}+S_{\bar{x}}$		Overall $\bar{X}+S_{\bar{x}}$
	HF (n=58)	RH (n=62)	2023 (n=70)	2024 (n=50)	<26 mo (n=53)	≥26 mo (n=67)	n=120
ST	NS6.41±0.18	6.79±0.15	NS6.57±0.14	6.63±0.19	NS6.62±0.16	6.58±0.14	6.66±0.10
CW	**6.05±0.24	4.61±0.20	NS5.14±0.19	5.53±0.25	**4.99±0.22	5.68±0.18	5.32±0.13
BD	NS5.41±0.16	5.46±0.14	**5.81±0.14	5.05±0.18	NS5.25±0.15	5.61±0.15	5.52±0.09
RA	NS6.25±0.30	7.27±0.26	NS6.88±0.14	7.04±0.31	NS6.88±0.27	7.04±0.23	6.97±0.17
RW	NS4.13±0.13	4.50±0.12	NS4.33±0.11	4.33±0.14	NS4.24±0.12	4.41±0.11	4.34±0.08
BCS	**4.48±0.15	5.11±0.13	NS4.96±0.13	4.63±0.16	NS4.86±0.14	4.73±0.12	4.83±0.09
RLV	**5.18±0.14	4.58±0.12	NS4.87±0.11	4.89±0.15	NS4.89±0.13	4.87±0.11	4.87±0.08
RLA	NS6.47±0.18	6.21±0.16	NS6.47±0.15	6.22±0.19	*6.57±0.17	6.12±0.14	6.33±0.10
HS	*5.30±0.16	4.81±0.14	NS5.02±0.13	5.09±0.17	NS5.07±0.15	5.04±0.13	5.04±0.09
FA	NS4.21±0.10	4.23±0.09	NS4.32±0.08	4.14±0.11	NS4.27±0.09	4.19±0.08	4.24±0.06
FUA	NS4.51±0.14	4.66±0.12	NS4.51±0.12	4.67±0.15	NS4.60±0.13	4.58±0.11	4.58±0.08
RUW	**6.04±0.16	5.42±0.14	NS5.80±0.13	5.66±0.17	NS5.62±0.15	5.84±0.12	5.74±0.09
RUH	**4.86±0.08	4.56±0.07	*4.84±0.06	4.58±0.08	NS4.73±0.07	4.69±0.06	4.73±0.04
CL	*5.59±0.13	5.17±0.11	NS5.32±0.11	5.45±0.14	NS5.37±0.12	5.40±0.10	5.37±0.07
UD	*8.61±0.14	8.11±0.12	NS8.35±0.12	8.37±0.15	NS8.36±0.13	8.36±0.11	8.35±0.08
RTP	NS5.70±0.29	6.27±0.29	*6.42±0.24	5.55±0.31	*5.61±0.27	6.36±0.23	6.11±0.17
FTL	*5.64±0.14	5.18±0.12	NS5.31±0.11	5.51±0.15	NS5.47±0.13	5.34±0.11	5.38±0.08
MA	*7.89±0.31	6.75±0.26	NS7.23±0.25	7.52±0.32	NS7.43±0.28	7.31±0.24	7.32±0.17

NS: Not significant. **: Significant for P<0.01. *: Significant for P<0.05. ST: stature, CW: chest width, BD: body depth, RA: rump angle, RW: rump width, BCS: body condition score, RLV: rear legs rear view, RLA: rear legs set angle, HS: hock structure, FA: foot angle, FUA: fore udder attachment, RUH: rear udder height, RUW: rear udder width, CL: central ligament, UD: udder depth, RTP: rear teat placement, FTL: fore teat length, MA: mammary acuity.

Statistical analysis

The following statistical model (1) was used to analyze the data:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl} \quad (1)$$

Where:

Y_{ijkl}: the observation of the traits; a_i: the effect of breed (i= HF and RH); b_j: the effect of calving year (j= 2023, 2024; c_k: the effect of first calving age (k= <26 months, ≥26 months) and e_{ijkl}: the random error. The GLM procedure of SAS (SAS, 2010) was used to analyse the data and the differences between the least-square means of fixed factor level were considered as statistically significant at P<0.05 (2-tailed), based on Tukey's adjustment type I error rate.

Results and discussion

The least square means (LSM) and the standard errors (SE) of linear and non-linear scores of the traits are presented in Tables 2 and 3.

Linear Type Traits

The LSM, SE and the significance of the linear type traits were summarized in Table 2. It was found that the breed effects on CW (P<0.01), BCS (P<0.01), RLV (P<0.01), HS (P<0.05), RUW (P<0.01), UD (P<0.01), CL (P<0.05), RUH (P<0.01), FTL (P<0.05) and MA (P<0.01) were found statistically significant and the overall mean scores for these traits were 5.32±0.13, 4.83±0.09, 4.83±0.09, 4.87±0.08, 5.04±0.09, 5.74±0.09, 4.73±0.04, 5.37±0.08, 8.35±0.08, 5.38±0.08 and 7.32±0.17, respectively.

Considering the significant differences of breed scores, the means for CW scores in HF (6.05±0.24) was bigger than RH cows (4.61±0.20) but, both scores were intermediate even though the HF score was better and promising, greater than the findings of Duru (2005) who found 4.59 as mean score in HF. The HF score was also bigger than 4.98±0.05 found by Çerçi & Koç (2006) in HF cows, also bigger than 5.5±0.1 found by Güler at al. (2018) in Brown-Swiss and 5.4±0.1 found by Güler et al. (2020) in Simmental cows even though the RH score was smaller than these scores. The HF score was also bigger than 5.00 score found by Erkmen & Kul (2021) in HF, bigger than 5.79 found by Alıç (2007) in HF and less than 6.56 found by Ermetin (2007) in HF, 6.83 by Marinov et al. (2015) in HF, 7.13 by Akdağ (2019) in HF and less than the mean 6.26 found by Ndihokubwayo & Koç (2024) in both HF and RH dairy cows. As for the BCS, the mean score for HF was 4.48±0.15 and 5.11±0.13 for RH and both scores were intermediate and the RH score was ideal (5-6) but, the HF score was also almost ideal, good and may improve later depending on the nutrition practices.

For the RLV scores in HF (5.18±0.14) and 4.58±0.12 in RH cows, both means are intermediate and almost ideal (5), but the HF mean was bigger than 4.89 score found by Duru (2005) in HF cows and both HF and RH means higher than 4.10 score found by Alıç (2007) in HF and smaller than 6.08 found by Ermetin (2007) in HF cows. Also, the mean score of the HS (5.30±0.16 in HF and 4.81±0.14 in RH) were both intermediate and the HF score was higher than 5.09±0.07 found by Çerçi & Koç (2006) in HF cows. As for the RUW, the mean score 6.04±0.16 in HF was found higher than 5.42±0.14 in RH but both scores were intermediate and good. Regarding the UD, even though 8.61±0.14 in HF was higher than 8.11±0.12 in RH, both scores were higher, meaning deep udder and they are suitable for dairy cows and these scores were found bigger than all the means found by other researchers about the UD trait. As for the RUH, the scores 4.86±0.08 in HF and 4.56±0.07 in RH were all intermediate and greater than 3.40 found by Akdağ (2019) in HF and less than the means found by Alıç (2007), Marinov et al. (2015), Duru (2005) and Erkmen (2020).

Table 3. Least square means and standard errors of non-linear 100 scores.

Factors	n	DS	Frame	FL	Udder	TS100
Breed		*	NS	*	*	**
HF	58	83.07±0.30	83.05±0.24	81.97±0.19	84.23±0.15	83.32±0.13
RH	62	81.61±0.26	83.13±0.21	81.27±0.16	83.71±0.13	82.71±0.11
Calving Year		NS	NS	NS	NS	NS
2023	70	82.15±0.25	83.05±0.20	81.75±0.16	84.00±0.13	83.02±0.11
2024	50	82.54±0.32	83.13±0.26	81.49±0.20	83.94±0.16	83.00±0.14
First Calving Age		NS	NS	NS	NS	*
<26 mo	53	82.23±0.27	82.83±0.22	81.59±0.17	83.83±0.14	82.84±0.12
≥26 mo	67	82.46±0.24	83.36±0.19	81.65±0.15	84.12±0.12	83.19±0.10
Overall	120	82.30±0.17	83.12±0.14	81.63±0.11	83.98±0.09	83.03±0.07

NS: Not significant. **: Significant for P<0.01. *: Significant for P<0.05. DS: dairy strength, FL: feet and legs.

For the CL, 5.59±0.13 in HF was found higher than 5.17±0.11 in RH and the HF score was a little less than Duru (2005) who found 5.39 in HF cows. For the FTL, 5.64±0.14 in HF was found higher than 5.18±0.12 in RH and both scores were intermediate and more than ideal (4). The RH score was similar to the one calculated by Gökçe (2011) and the HF score was greater than Çerçi & Koç (2006), Ermetin (2007), Marinov et al. (2015) and Erkmen (2020) and less than 6.52 score found by Akdağ (2019). As far as the MA is concerned, 7.89±0.31 of HF was higher than 6.75±0.26 in RH cows and both scores show a perfect udder, fact that is suitable for the farmers.

Also, in this study, the effects of calving year on BD (P<0.01) and RUH (P<0.05) and the first calving age on CW (P<0.01), RLA (P<0.05) and both effects on RTP (P<0.05) were found statistically significant. In this study, the significant effect of first calving age on BD was also found by Erdem et al. (2017) in their study aimed at determining the changes in linear type trait scores in Simmental cows.

Comments about Some Linear Type Traits

In conformation recording, the extreme (very small or very high) scores are not preferable for most of the traits in dairy cows (Table 1) and may be the cause of early culling of cows from the herd, shortening the herd life. There are also some scores that are ideal when they are higher. For example, the wider chest means the high capacity of liver and heart. The extremes for RLA (very straight or very sickled legs) are not ideal because they limit the walking capability and can cause the disability of the cow (Şahin, 2011). They can also cause foot and legs lesions (Kumlu, 2000; Çerçi & Koç, 2006). Also, when the udder is higher, it is great for lactating cows for mastitis resistance because when the udder is deeper, it is closer to the ground and is susceptible to catch mastitis. The intermediate scores that are between 4 and 6 are good and the most of the scores that were calculated in this study were intermediate and good.

Non-linear 100 Scores

As a second method of conformation recording, the non-linear 100 scores method was used and the LSM and their SE were detailed in Table 3. In this study, the effects of breed on DS (P<0.05), FL (P<0.05), udder (P<0.05) and the TS (TS100 P<0.01) were found statistically significant and their overall means were 82.30±0.17, 81.63±0.11, 83.98±0.09 and 83.03±0.07, respectively. Regarding the breeds (HF and RH), only the effect of breed on frame was not significant (P>0.05). The breed effect on some udder traits was also found by Mazza et al. (2016) and Ndihokubwayo & Koç (2024) and they all advised that more importance may be put on udder traits during selection based on type traits. The fact of not finding the frame difference between the HF and RH cows may be explained that these two breeds differ only by colour genes, have been taken as different breeds since the 1950's and until now they do not show a remarkable difference in body traits. Other effects such as the calving year and the first calving age were not found statistically significant unless the first calving age on TS100 (P<0.05). Regarding the breed effect of non-linear 100 scores, all the found scores were greater than the findings of Duru (2005), Alıç (2007), Ermetin (2007) and Erkmen (2020) and were less than the findings of Akdağ (2019). Generally, all the mean scores found for the non-linear method were good plus and suitable for a dairy herd.

Prediction of the Future of the Dairy Cows According to the Breed Effect

The CW mean score, which is higher in HF (6.05±0.24) than RH (4.61±0.20) cows, will make farmers choose them than RH cows. As for the BCS, which is a little higher and ideal in RH (5.11±0.13) than HF (4.48±0.15) may change within the time depending on nutrition practices and other farm management factors and cannot help in deciding for the future prediction of dairy cows. The HS is promising for HF (5.30±0.16) than RH (4.81±0.14) for the future but, based on the current score difference, this should cause the early culling of RH than HF cows. As for the RUW, RUH and CL will continue to improve in both breeds as the udder development increases with increased parities. The UD scores for both HF (8.61±0.14) and RH (8.11±0.12) are promising actually and the mastitis incidence in the herd is reduced but, in the future, the UD score will decrease as the parity increases and the high intensity of decrease is generally seen in RH cows than HF. Berry et al. (2022) also confirmed that some of the type traits may be altered within the time, reason why some udder traits' scores may vary within the time. The FTL and MA for both HF and RH are quite promising even in the future. As far as the non-linear 100 scores is concerned, all the significant traits (for breed) were seen to be generally a little higher in HF cows than RH and the TS100 (83.32±0.13 for HF and 82.71±0.11 for RH) were both good plus and suitable for farming dairy cows.

Conclusion

This study showed the importance of using type traits as a tool for classifying dairy cattle. The significant breed effect found in most of type traits showed that HF and RH genotypes, which differ only in color genes, have been considered and reared as different breeds since the 1950's, causing significant differences in some type traits of these two genotypes. The extreme scores of type traits may cause early culling of the cows, reducing herd life. The animals used here were in their first lactation, the scores of most of the traits will change as the parities will increase and it was given a future prediction of the dairy cows in this herd. Finally, the two methods used in this study showed coincidences for the significance of the breed effect on most of the type traits.

Declarations

This study was presented at the 7th International Anatolian Agriculture, Food, Environment and Biology Congress, (Kastamonu, TARGID 2024)

Conflict of Interest

The authors declare no conflict of interest.

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