A brief Statistical Analysis Regarding the Fat Content of Milk Obtained from the Holstein and Simmental Breeds

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Abstract

The purpose of this paper was to carry out a short statistical analysis on the fat content of milk from two breeds of cattle from a farm in the Moldavian area. 30 milk samples were analysed, more precisely 23 from the Holstein breed and 7 from the Simmental breed in two periods, such as the cold season (autumn-winter) and the warm season (spring-summer). It is known that these breeds are among the best breeds of cows for milk, the first being considered the most productive in the world, and the second the best breed of cows for farms in Romania. The Holstein breed is a highly specialized breed for milk production, while the Simmental breed is a dual-purpose breed selected for both meat and milk production. Following the statistical analysis, it can be seen that there were significant differences between the two breeds of cattle studied and also between the milk fat content recorded in the cold season compared to the fat content recorded in the warm season. The value of P was less than 0.0001, confirming the heterogeneity of the data recorded in the two seasons. The main conclusion is that for the total experiment, the data are significant (alpha=5%).

Keywords: breeds of cows, fat content, milk, season

1. Introduction

At the European level, the milk sector ranks first in agricultural production. In Romania, the main source of milk comes from private sector animal breeding units, which provide over 95% of the total milk production [1]. In terms of importance, the Simmental breed ranks second as a breed in Europe, after the Holstein Friesian and Holsteinized populations, if you take into account the overall picture of the breeds (breed population size, milk production, meat production) [2]. The Holstein breed is a specialized breed for milk production, while the Simmental breed is a breed that has a dual purpose: meat production, but also milk production [3]. A Holstein cow will typically produce on average between 22 and 40 litres of milk/day or 12,000 litres/lactation. This aspect depends a lot on the stage of breastfeeding and their age. A Simmental breed cow produces up to 25.4 litres of milk/day as yield [4]. Milk has a fairly high nutritional value because its constituents include water, milk fat, protein, lactose and minerals [5]. The effect of seasonal fluctuations on milk production and composition has been widely investigated by some researchers in the dairy industry, thus it has been found that milk components vary according to milking time, DIM, seasonal period and cow health [6]. Milk fat is a complex made up of simple lipids, such as triglycerides, diglycerides and monoglycerides, but also complex lipids, specifically phospholipids, lecithin, cephalin and sphingomyelin [7]. There are also derivatives of lipids (free fatty acids [FA]) and substances associated with fats (sterols, cholesterol, fat-soluble vitamins A, E, D and K and carotenoids) [8]. Milk fat content and free fatty acid composition are of great interest for human nutrition worldwide

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[9]. Milk fat contains more than 400 free fatty acids [10]. The milk fatty acid profile can be seen as a trace of the cow's nutrition and metabolism and can be used to draw conclusions about different farming or forage systems or even as a factor influencing cow health [11].

2. Materials and methods

The data collected for this research concerned the analysis of the fat content of 30 milk samples. In our study, two different cattle breeds Holstein and Simmental were taken into account. A number of 23 milk samples from the Holstein breed, respectively 7 milk samples from the Simmental breed from a farm in the Moldavian area were analysed. The milk fat content of the two cattle breeds in two seasons: cold season and warm season was analysed. The work steps followed after creating the database were the calculation of some statistical parameters (median, mean, standard deviation, standard error of the mean, confidence limit of the mean, minimum value and maximum value), formulating statistical hypotheses, choosing the significance threshold (α = 0.05) and last but not least the difference in fat content between the cold season and the warm season for choosing the type of T-student test used. The milk samples were analysed with Combiscope Delta Instruments FTIR 300/600 HP, fast analyser that can measure 300/600 raw milk samples per hour. The technologies used (FTIR and LED flow cytometry) make this device among the fastest and most accurate analysers with a low operating cost. The Combiscope consists of two analysers: LactoScope FTIR 300/600 HP (chemical analyses) and SomaScope LFC 300/600 HP (somatic cells) (Figure 1).

Figure 1. Combiscope Delta Instruments FTIR 300/600 HP

3. Results and discussion

Table 1 presents the fat content values recorded in the case of the 30 analysed milk samples. Following the statistical parameters calculated in table 1, we can see that in the cold season, the fat content had an average of 4.778%, while in the warm season there was an average of 4.143% of the fat content specific to the two breeds of cattle. The average difference for the fat content recorded in the cold season compared to that recorded in the warm season was 0.63%.

Table 1. Fat content parameters recorded for 30 milk samples

No.	Cattle breed	Fat content (%)		Difference (%)
		COLD SEASON	HOT SEASON	
1	HOL	4.66	4.02	0.64
2	HOL	4.96	2.56	2.4
3	HOL	5.34	3.99	1.35
4	HOL	4.57	4.11	0.46
5	HOL	3.88	3.72	0.16
6	HOL	6.37	4.78	1.59
7	HOL	4.37	4.26	0.11
8	HOL	5.46	4.25	1.21
9	HOL	4.54	3.65	0.89
10	HOL	3.66	3.05	0.61
11	HOL	4.79	4.55	0.24
12	HOL	5.34	4.77	0.57
13	HOL	4.52	4.29	0.23
14	HOL	4.96	3.78	1.18
15	HOL	4.38	4.3	0.08
16	HOL	4.39	4.33	0.06
17	HOL	4.33	4.22	0.11
18	HOL	5.16	3.87	1.29
19	HOL	4.64	3.82	0.82
20	HOL	3.89	3.44	0.45
21	HOL	5.72	4.91	0.81
22	HOL	5.8	5.1	0.7
23	HOL	4.89	4.12	0.77
24	SIM	4.27	4.1	0.17
25	SIM	4.65	4.3	0.35
26	SIM	4.61	4.32	0.29
27	SIM	4.86	4.79	0.07
28	SIM	4.84	3.98	0.86
29	SIM	4.19	4.11	0.08
30	SIM	5.31	4.8	0.51
Median		4.655	4.17	0.54
Average		4.778	4.143	0.63
Standard deviation		0.60	0.54	0.54
Standard error		0.219	0.197	0.199
Average confidence limit		1.78	1.78	1.78
Minimum value		3.66	2.56	0.06
Maximum value		6.37	5.1	2.4

To choose the type of Student's T-test, we first performed the F-test to see the type of variance (equal or unequal). Following the application of the F-test, the value P = 0.039525283 < 0.05, which means that the variances present statistically significant differences, therefore the T-student test is applied, with unequal variants (Table 2).
Applying the Student's t-test, with unequal variances, resulted in a value of P = 0.022289029 < 0.05, which means that there are statistically significant differences (between the two races) because we reject the null hypothesis that these differences do not exist and accept the hypothesis alternative with a risk of error less than 0.05 (Table 3).
To check for statistically significant differences, we applied the Student's t-test, Paired Two Sample for Means. After applying this test, the P value = 5.85E-07 < 0. 0. which means that there are statistically significant differences between the two seasons: cold and warm (Table 4).

Table 2. F-Test Two-Sample for Variances

	Variable 1 (HOLSTEIN)	**Variable 2 (SIMMENTAL)**
Mean	0.727391304	0.332857143
Variance	0.334383794	0.078490476
Observations	23	7
df	22	6
F	4.260183027	
P (F<=f) one-tail	**0.039525283**	**P = 0.039525283 < 0.05, which means that the Student t-test is applied for unequal variances**
F Critical one-tail	3.856403079	

Table 3. t-Test: Two-Sample Assuming Unequal Variances

	Variable 1 (HOLSTEIN)	**Variable 2 (SIMMENTAL)**
Mean	0.727391304	0.332857143
Variance	0.334383794	0.078490476
Observations	23	7
Hypothesized Mean Difference	0	
df	22	
t Stat	2.45858147	
P(T<=t) one-tail	0.011144515	
t Critical one-tail	1.717144374	
P(T<=t) two-tail	**0.022289029**	**P = 0.022289029 <0.05, which means that there are statistically significant differences between the two breeds and the alternative hypothesis is accepted**
t Critical two-tail	2.073873068	

Table 4. t-Test Paired Two Sample for Means

	Variable 1 (COLD SEASON)	Variable 2 (WARM SEASON)
Mean	4.778333333	4.143
Variance	0.360359195	0.292559655
Observations	30	30
Pearson Correlation	0.545440984	
Hypothesized Mean Difference	0	
df	29	
t Stat	6.366979636	
P(T<=t) one-tail	2.92499E-07	
t Critical one-tail	1.699127027	
P(T<=t) two-tail	**5.85E-07**	**The value of P is very small, <0.001, which denotes that the differences are significant between the two seasons: cold and warm**
t Critical two-tail	2.045229642	

4. Conclusions

Following the statistical analysis, it can be observed that there were significant differences between the two breeds of cattle studied and also between the fat content of the milk recorded in the cold season compared to the fat content recorded in the warm season. It was found that the season and the breed showed significant differences regarding the physical-chemical parameters, more precisely the fat content of the cow's milk.

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