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INVESTIGATING HEREDITARY DISORDERS OF SIMMENTAL FROZEN BULL SEMEN IMPORTED TO TÜRKİYE DURING 10-YEAR PERIOD

Mustafa ÇAM[1]*, Şeref İNAL[1]

[1]*Selcuk University, Faculty of Veterinary Medicine, Department of Animal Science, 42003, Konya, Türkiye*

Abstract: This study was aimed to determine hereditary defects of frozen Simmental bull semen imported to Turkiye between 2013 and 2022. As the source of this study, the websites of various companies that produce semen, bull catalogues, and databases of bull semen companies have been used. A total of 13 websites including Simmental semen databases and bull catalogues were investigated. The result of the study showed that 438 of 1301 Simmental bull's frozen semen carry at least one genetic defect during 10-year period of import. The most common hereditary defects are Bovine Male subfertility (BMS) for 164 frozen bull semen, Trombopathia (TP) for 155 bull semen and Fleckvieh Haplotype 4 (FH4) for 127 bull semen respectively. Significant effect was observed between different years and the rate of carriers was significantly decreased after 2019. As for origin of bull semen, the bull semen imported from Czech Republic showed significantly the least hereditary defect rate compared with those imported from Austria, Germany and Italy.

Keywords: Simmental bull sperm, Hereditary disorders, Genetic defects

***Corresponding author:** Selcuk University, Faculty of Veterinary Medicine, Department of Animal Science, 42003, Konya, Türkiye
E mail: mustafa.cam@selcuk.edu.tr (M. ÇAM)
Mustafa ÇAM https://orcid.org/0000-0002-1821-191X
Şeref İNAL https://orcid.org/0000-0003-4746-8930

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1. Introduction

The practice of artificial insemination (AI) is so prevalent in Türkiye. Nearly all the cows and heifers in the registered farms get pregnant by AI. A great portion of frozen semen used in Türkiye is imported. The procedures and principles regarding the import of semen, ovum and embryo were issued by General Directorate of Livestock of Ministry of Agriculture and Forestry. There are some important hereditary diseases which should be taken into consideration. However, there is no regulation or prohibition against importing Simmental bull frozen semen carried hereditary disorders. Hereditary defects are important for genetic pollution of livestock herds in the worldwide. Therefore, the raised bulls or the frozen semen should be tested for hereditary diseases and the results of analyses should be specified in pedigrees or information cards. İnal and Çam (2016) reported just the prevalence of hereditary disorders of imported semens in 2015. Since there is lacking of hereditary disorder information for frozen bull semen imported to Türkiye, a comprehensive study is needed to investigate occurrence of Simmental bull semen using the all revealed data via General Directorate of Livestock of Ministry of Agriculture and Forestry. So this study was aimed to determine hereditary defects of frozen Simmental bull semen imported to Türkiye between 2013 and 2022.

2. Materials and Methods

The name and ID of the bull, the importing company and the number of straws are the list of imported bulls issued by General Directorate of Livestock of Ministry of Agriculture and Forestry. In this study, hereditary status of imported Simmental bulls between 2013 and 2023 were examined and a category was created according to years and origins.

Table 1. Websites of various companies used in the study

Company	Websites
Center of Moruzzo	www.en.ctsmoruzzo.it
Libro Genealogico	www.online.anapri.it
Zuchtwert Austria	www.zuchtwert.at
ST Genetics	www.stgen.com
Accelerated Genetics	www.accelgen.com
Synetics	www.evolution-xy.fr
Swiss Genetics	www.swissgenetics.com
Superbrown	www.superbrown.it
Göpelgenetik	www.goepelgenetik.de
CBBA	www.db.cschms.cz
Munster Bovine	www.munsterbovine.ie
Melapolskie Centrum	www.mcb.com.pl
Aberekin	www.aberekin.com

Bulls were combined for general examination, reducing the number to 1302 bulls (13,113,327 straws) (Table 1). Some bulls with beef origin were excluded from the study due to the fact that their pedigrees don't include hereditary disorders.

Table 1 showed websites of various companies that produce semen, bull catalogues and database of bull semen in Simmentals.

Effect of number of carriers on different year and origin was analyzed using Chi-Square analysis in SPSS (ver. 25.0). %5 confidence interval was accepted for the significance level of the tests

3. Results and Discussion

Simmental breeding in Türkiye is getting popular day by day. The primary purpose of Simmental cattle breeding imported to Türkiye is for dairy production. So the majority of the Simmental bulls imported between 2013 and 2022 were for dairy production. Totally, 438 of 1301 bulls carried at least one genetic defect as a result of the research. The type of each hereditary defects of Holstein bulls were summarized in Table 2.

Table 2. Hereditary defects of the Simmental frozen semen imported between 2013 and 2022

HD[1]	Bulls n	Straw n
A[2]	0	0
DW[3]	4	25964
FH2[4]	55	360811
FH4[5]	127	906108
FH5[6]	51	468718
BH2[7]	42	403256
BMS[8]	164	1386618
ZL[9]	8	53121
TP[10]	155	1101387

[1]Hereditary Defect, [2]Arachnomelia, [3]Dwarfism, [4]Flekvieh Haplotype 2, [5]Flekvieh Haplotype 4, [6]Flekvieh Haplotype 5, [7]Braunvieh Haplotype 2, [8]Bovine Male Subfertility,[9]Zinc Deficiency, [10]Trombopathia.

Table 3. Effect of year on occurrence of hereditary defects of the Simmental bull frozen semen

Year	Bull (n)	CR[1] (n)	SNC[2]	TSN[3]
2013	92	39.1[ab] (36)	176599	533881
2014	146	44.5[a] (65)	414876	1008256
2015	168	45.8[a] (77)	596778	1252819
2016	233	42.1a (98)	682012	1705780
2017	159	39.0[ab] (62)	524924	1472013
2018	229	31.4[abc] (72)	764619	2171580
2019	183	24.6[cd] (45)	344425	1454485
2020	244	30.3[bcd] (74)	467988	1343418
2021	214	26.2[cd] (56)	333572	1258967
2022	174	21.8[d] (38)	186432	912128

[a, b, c, d]; different superscripts in the same column show significant differences (P<0,001). [1]carriers rate, [2]straw number of carriers [3]total straw number.

The significant decrease in number of carriers imported in different years became prominent after 2018 (Table 3). Among 1301 Simmental bulls, It was determined that 4 bulls carried Dwarfism, 8 bulls carried Zinc Deficiency. Flekvieh Haplotype 2 (FH2) gene causing deficiency of growth in Simmentals can be another form of dwarfism (Burgstaller et al., 2016). It was determined that 55 Simmental bulls carried FH2. FH4 gene for Simmentals decreases the pregnancy rate like Holstein haplotype genes (Ling et al., 2018). Calves with FH4 genes can't survive because the homozygous FH4 gene causes zygote death. It was determined that 127 Simmental bulls of frozen semen carried FH4. FH5 is a new haplotype for Simmental causing death with symptoms of heart and liver failure in 48 hours after birth (Emmerling, 2015). 9 Simmental bulls carried FH5. 42 Simmental bulls carried Braunvieh Haplotype 2 (BH2) gene which is normally found in Brown Swiss Haplotype. Calves carrying BH2 genes as homozygous are either born dead or die after birth. 37 Simmental bulls were determined to be carrier of Trombopathia characterized by impaired blood coagulation (Ling et al., 2018). 32 bulls were found to have carrier of Bovine Male Subfertility gene causing sterility of bulls (Ling et al., 2018) and not problem for Türkiye (Table 4). It would be a problem in case Türkiye will start to have AI bulls for breeding. Given that 4705983 doses of frozen semen belonging to these bulls were imported and used in Türkiye, which can be concluded that Simmental breeding faces a grave serious genetic pollution.

Table 4. Effect of bull origin on occurrence of hereditary defects of the Simmental frozen semen

Origin	n	CR[1]	PNC[2]	TPN[3]
AT[4]	227	30,8[b] (70)	830146	2073004
CZ[5]	103	17.,5[c] (18)	237278	877278
DE[6]	861	38.2[a] (329)	2391557	6558026
IT[7]	48	35.4[ab] (17)	73601	441074

[a, b]; different superscripts in the same column show significant differences (P<0.001) [1]carriers rate, [2]straw number of carriers [3]total straw number [4]Austria [5]Czech Republic [6]Germany [7]Italy

5. Conclusion

This study highlights the importance of genetic pollution in imported bull semen. Even though there was a limited study investigating hereditary defects of imported semen to Türkiye; this research was the first to examine all hereditary disorders throughout ten-year period. The result of this study encourages authorities to make more precautions during importing frozen bull semen against genetic pollution.

Author Contributions

The percentage of the author(s) contributions is presented below. All authors reviewed and approved the final version of the manuscript.

	M.Ç.	Ş.İ.
C	80	20
D	80	20
S		100
DCP	100	
DAI	50	50
L	100	
W	70	30
CR	50	50
SR	70	30
PM	50	50
FA	50	50

C=Concept, D= design, S= supervision, DCP= data collection and/or processing, DAI= data analysis and/or interpretation, L= literature search, W= writing, CR= critical review, SR= submission and revision, PM= project management, FA= funding acquisition.

Conflict of Interest

The authors declared that there is no conflict of interest.

Ethical Consideration

Ethics committee approval was not required for this study because of there was no study on animals or humans.

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