DOI: 10.22055/IVJ.2020.206223.2193
DOR: 20.1001.1.17356873.1400.17.2.10.3

Association between milk β-casein protein polymorphism and reproductive indices in Holstein dairy cows

Farideh Norvej[1], Abdolah Mirzaei[2*], Hassan Sharifiyazdi[3] and Abolfazl Hajibemani[4]

[1] DVM Graduated, Faculty of Veterinary Medicine, Shiraz University, Shiraz, Iran
[2] Associate Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shiraz University, Shiraz, Iran
[3] Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, Shiraz University, Shiraz, Iran
[4] Assistant Professor, Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Tabriz, Tabriz, Iran

Received:23.10.2019 Accepted: 13.01.2020

Abstract

The aim of the present study was to detect Holstein dairy cows with two allelic forms of A1 and A2 of milk β-casein gene and compare their reproductive indices. The blood samples were collected from 41 multiparous (without pre and postpartum clinical diseases) Holstein cows in a modern dairy herd. DNA was extracted from whole blood and the β-casein genotype was detected by polymerase chain reaction-restriction fragment length polymorphism (PCR-RFLP) analysis using *BstDE I* (*Dde I*) enzyme based on the replacement of the proline by histidine at position 67 β-casein protein in A1 milk. The PCR products sequenced for each genotype which used as control samples to validate the RFLP findings. The reproductive indices between cows with different genotypes were compared by Kruskal–Wallis test. The results of the present study indicated that A1A1, A1A2 and A2A2 genotype had a frequency of 13 (31.7%), 21 (51.2%) and 7 (17.1%). No significant difference was found in calving to first service interval, days open and service per conception indices between studied cows with different β-casein genotypes ($P > 0.05$). As results, it seems that the identification and proliferation of cows with the allelic form of A2 of β-casein gene can be considered without adverse effects on the fertility of dairy cows. However, further studies are needed to investigate the relationship between this genotype and milk yield of cows in the dairy herds.

Key words: Fertility, β-casein, Genotype, Dairy cow

[*] **Corresponding Author**: Abdolah Mirzaei, Associate Professor, Department of Clinical Sciences, School of Veterinary Medicine, Shiraz University, Shiraz, Iran
E-mail: mirzaei@shirazu.ac.ir

Refrences

Abdel-Rahman, S. M., & Ahmed, M. M. M. (2007). Rapid and sensitive identification of buffalo's, cattle's and sheep's milk using species-specific PCR and PCR–RFLP techniques. *Food Control*, 18(10), 1246-1249.

Berry, D. P., Friggens, N. C., Lucy, M., & Roche, J. R. (2016). Milk production and fertility in cattle. *Annual review of animal biosciences*, 4, 269-290.

Crowe, M. A., Hostens, M., & Opsomer, G. (2018). Reproductive management in dairy cows-the future. *Irish veterinary journal*, 71(1), 1-13.

De Noni, I. (2009). Scientific report of efsa review of the potential health impact of β-casomorphins and related peptides 1 Report of the DATEX Working Group on β-casomorphins.

Dematawewa, C. & Berger, P. (1998). Genetic and Phenotypic Parameters for 305-Day Yield, Fertility, and Survival in Holsteins. *Journal of dairy science*, 81(10), 2700-2709.

Demeter, R., Markiewicz, K., Van Arendonk, J. & Bovenhuis, H. (2010). Relationships between milk protein composition, milk protein variants, and cow fertility traits in Dutch Holstein-Friesian cattle. *Journal of dairy science*, 93(11), 5495-5502.

Felenczak, A., Gil, Z., Adamczyk, K., Zapletal, P. & Frelich, J. (2008). Polymorphism of milk κ-casein with regard to milk yield and reproductive traits of Simmental cows. *Journal of Agrobiology*, 25(2), 201-207.

Formaggioni, P., Summer, A., Malacarne, M., & Mariani, P. (1999). Milk protein polymorphism: Detection and diffusion of the genetic variants in Bos genus. *Annalli della Facolta di Medicina Veterinaria Universiti de Parma*, 19, 127-165.

German, J.B., Dillard, C.J. & Ward, R.E. (2002). Bioactive components in milk. *Current Opinion in Clinical Nutrition & Metabolic Care*, 5(6), 653-658.

Gouda, E. M., Galal, M. K., & Abdelaziz, S. A. (2013). Genetic variants and allele frequencies of kappa casein in Egyptian cattle and buffalo using PCR-RFLP. *Journal of Agricultural Science*, 5(2), 197.

Groenen, M.A. & Van der Poel, J.J. (1994). Regulation of expression of milk protein genes: a review. *Livestock Production Science*, 38(2), 61-78.

Hamza, A. (2010). Kappa Casein Gene Polymorphism and its Impact on Milk Yield and Reproductive Performance Traits of Chinese Holstein Cattle** AE Hamza," ZP Yang, XL Wang," RJ Chen," HT Wu and" AI Ibrahim" College of Animal Science and Technology, Yangzhou University, Yangzhou, Jiangsu, China "Department of Animal Production, College of Veterinary Science, Nyala University, Nyala, Sudan. *Agricultural Journal*, 5(5), 283-285.

Hargrove, G., Kiddy, C., Young, C., Hunter ,A., Trimberger, G. & Mather, R. (1980). Genetic Polymorphisms of Blood and Milk and Reproduction in Holstein Cattle1, 2. *Journal of dairy science*, 63(7), 1154-1166.

Hayes, J.; Cue, R. & Monardes, H. (1992). Estimates of repeatability of reproductive measures in Canadian Holsteins. *Journal of dairy science*, 75(6), 1701-1706.

Hodel, F., Moll, J. & Kuenzi, N. (1995). Analysis of fertility in Swiss Simmental cattle—Genetic and environmental effects on female fertility. *Livestock Production Science*, 41 (2), 95-103.

Jairam, B. & Nair, P. (1901). Genetic polymorphism of milk proteins and economic characters in dairy animals.

Kamiński, S., Cieślińska, A. & Kostyra, E. (2007). Polymorphism of bovine beta-casein and its potential effect on human health. *Journal of applied genetics*, 48(3), 189-198.

Keating, A.F., Smith, T.J., Ross, R.P. & Cairns, M. (2008). A note on the evaluation of a beta-casein variant in bovine breeds by allele-specific PCR and relevance to β-casomorphin. *Irish Journal of Agricultural and Food Research*, 99-104.

Lin, C. (1992). Direct typing of milk proteins as an aid for genetic improvement of dairy bulls and cows: a review. *In: Animal Breeding Abstracts*, 1-10.

Lin, C.Y., McAllister, A.J., Ng-Kwai-Hang, K.F., Hayes, J.F., Batra, T.R., Lee, A.J., Roy, G.L., Vesely, J.A., Wauthy, J.M. & Winter, K.A. (1987). Association of Milk Protein Types with Growth and Reproductive Performance of Dairy Heifers. *Journal of Dairy Science*, 70(1), 29-39.

Martin, P., Szymanowska, M., Zwierzchowski, L. & Leroux, C. (2002). The impact of genetic polymorphisms on the protein composition of ruminant milks. *Reproduction Nutrition Development*, 42(5), 433-459.

Mclachlan, C.N.S. (2006). Breeding and milking cows for milk free of β-casein A1. Google Patents.

Niki, R., Kim, G., Kimura, T., Takahashi, K., Kohyama, K. & Nishinari, K. (1994). Physical properties and microstructure of rennet gels from casein micelles of different sizes. Milchwissenschaft (Germany).

Nilsen, H., Olsen, H.G., Hayes, B., Sehested, E., Svendsen, M., Nome, T., Meuwissen, T. and Lien, S. (2009). Casein haplotypes and their association with milk production traits in Norwegian Red cattle. *Genetics Selection Evolution*, 41(1), 1-12.

Parashar, A., & Saini, R. K. (2015). A1 milk and its controversy-a review. *International Journal of Bioassays*, 4(12), 4611-4619.

Peñagaricano, F. & Khatib, H. (2012). Association of milk protein genes with fertilization rate and early embryonic development in Holstein dairy cattle. *Journal of Dairy Research*, 79(1), 47-52.

Pryce, J., Royal, M., Garnsworthy, P. & Mao, I.L. (2004). Fertility in the high-producing dairy cow. *Livestock production science*, 86(1-3), 125-135.

Roginski, H., Fuquay, J.W. & Fox, P.F. (2003). Encyclopedia of dairy sciences. Volumes 1-4, Academic press.

Ruottinen, O., Ikonen, T. & Ojala, M. (2004). Associations between milk protein genotypes and fertility traits in Finnish Ayrshire heifers and first lactation cows. *Livestock production science*, 85(1), 27-34.

Shah, N.P. (2000). Effects of milk-derived bioactives: an overview. *British Journal of Nutrition*, 84, 3-10.

Swinburn, B. (2004). Beta casein A1 and A2 in milk and human health. Report to New Zealand Food Safety Authority.

Tsiaras, A., Bargouli, G., Banos, G. & Boscos, C. (2005). Effect of kappa-casein and beta-lactoglobulin loci on milk production traits and reproductive performance of Holstein cows. *Journal of dairy science*, 88(1), 327-334.

Veerkamp, R. & Beerda, B. (2007). Genetics and genomics to improve fertility in high producing dairy cows. *Theriogenology*, 68, S266-S273.

Veerkamp, R., Beerda, B. & Van der Lende, T. (2003). Effects of genetic selection for milk yield on energy balance, levels of hormones, and metabolites in lactating cattle, and possible links to reduced fertility. *Livestock Production Science*, 83(2-3), 257-275.

Weigel, K. & Rekaya, R. (2000). Genetic parameters for reproductive traits of Holstein cattle in California and Minnesota. *Journal of Dairy science*, 83(5), 1072-1080.

Welper, R. & Freeman, A. (1992). Genetic Parameters for Yield Traits of Holsteins, Including Lactose and Somatic Cell Score1. *Journal of Dairy Science*, 75(5), 1342-1348.

Woodford, K.B. (2007). A2 milk, farmer decisions, and risk management. *In: Proceedings of the 16th International Farm Management Congress: Peer reviewed papers*, 641-648.