

Uridine Monophosphate Synthase of Jersey Bulls¹

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ABSTRACT

Fifteen Jersey sires, with a significant impact on the breed in the United States, were assayed for activity of uridine monophosphate (UMP) synthase. Six of these bulls were the highest ranking Jersey bulls, as of July 1987, with cheese yield dollars averaging \$165. These 15 bulls sired over one-third of all Jersey sons registered in 1986 and 1987 and have sired approximately 14,000 of the 37,000 lactating daughters contributing to active AI sire evaluations in 1988. These bulls represent a cross-section of the Jersey breed as they have 11 different sires; 7 different, additional maternal grandsires; and their five-generation inbreeding coefficients average 1.5%. Activity of UMP synthase was $3.14 \pm .24$ units/ml with a range from 2.74 to 3.58 units/ml. The coefficient of variation of 7.7% was slightly less than previously reported coefficients of variation for Holsteins. All these Jersey sires had activities within normal expectations, above delimiter of two thirds of average, and none should be considered heterozygous for UMP synthase. Although this is insufficient proof of absence of the undesirable UMP synthase allele among Jerseys, it is reassuring that no heterozygotes were found among these popular Jersey sires.

INTRODUCTION

Uridine monophosphate (UMP) synthase is an enzyme in the pyrimidine biosynthesis pathway that is essential for normal growth and development (2). In Holsteins, animals with approximately half the normal activity of UMP synthase have been identified as heterozygotes (7) and represent 1 to 2% of the US Holstein population (3, 6). One bull (Skokie Sensation Ned) was an ancestor of all heterozygous bulls in AI (6). Matings between heterozygotes are not recommended because approximately one-fourth of the conceptions do not survive to term (5). Animals with deficiency of UMP have been identified among Holsteins, but reports for other breeds do not exist. The Holstein progenitor had a reputation for high fat and protein content in his daughter's milk. The high solids in Jersey milk made them an appropriate breed to test for UMP synthase deficiency. This study evaluated the activity of UMP synthase among popular Jersey bulls. The objective was to determine whether the undesirable UMP synthase allele would be widely distributed in the subsequent generation.

MATERIALS AND METHODS

American Jersey Cattle Club (AJCC) identified six bulls they considered to be elite (Highland Magic Duncan, A-Nine Top Brass, Palmer Fascinator George, JS Quicksilver Royal, Yankee FW Chief, and Reliant-ET). These bulls were the top 6 ranking bulls for cheese yield dollars in the July 1987 sire summary. In the July 1988 sire summary, 4 elite bulls remain among the top 6 bulls for cheese yield dollars and the other 2 elite bulls are in the top 12. They are having a significant impact on the breed via more than 34,000 daughters and 2500 sons. The AJCC recognized the importance of identifying carriers of undesirable

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TABLE 1. Background information on Jersey bulls.¹

	Elite bulls ²	Control bulls ³
Number	6	9
Average inbreeding	1.8	1.3
Range in inbreeding	0 to 6.25	0 to 5.47
Registered daughters	34756	11699
Registered sons	2528	482
Cheese yield dollars	165	72
Predicted Difference milk	1278	681
Predicted Difference fat	56	30
Predicted Difference dollars	166	89
Predicted Difference protein	40	13
Predicted Difference type	1.13	.72
Production type index	300	146

¹ Registrations are as of August 18, 1988; Predicted Differences are from January 1988 Sire Summary.

² American Jersey Cattle Club requested that the high cheese yield dollar bulls be sampled for deficiency of uridine monophosphate synthase.

³ Each participating artificial insemination organization sampled one or more control bulls with each elite bull. Seven of 9 had data on Predicted Differences.

genetic defects among this group of bulls. Additional information on the exceptional genetic merit of these elite bulls is in Table 1.

Blood samples from each bull were received in fall 1987 from their housing locations across the country. At least two blood samples, elite plus control bull, were requested from each location to avoid confounding of sample and location. This is routine procedure for all UMPS synthase deficiency testing. Preliminary analysis indicated that consideration of location was not needed for these samples. Nine control bulls

were sampled as some AI organizations sent blood samples on several bulls. Background information on the control bulls is in Table 1.

None of the Jersey bulls sampled was highly inbred. Sires and maternal grandsires of sampled bulls are in Table 2. Eighteen different bulls are represented in the two-generation pedigrees of the 15 sampled bulls. Only 2 sires (Shadewell Fascinator and Observer Chocolate Soldier) had more than one son sampled. Both Observer Chocolate Soldier and Milestone Generator had several maternal grandsons sampled. Further

TABLE 2. Sires and maternal grandsires of sampled bulls.

Sires of sampled bulls	Maternal grandsires of sampled bulls
Shadewell Fascinator (4) ¹	Observer Chocolate Soldier (5)
Observer Chocolate Soldier (2)	Milestone Generator (4)
Briarcliffs Brave Soldier	Briarcliffs Black Magic
Briarcliffs Observing Performer	Brigham Vol Zev of Ogston
Briarcliffs Soldier Boy	Bruce Westfield Cherry Noble
Favorite Saint	Milkhoney General
Highland Magic Duncan	Secret Welcome Reliance
Master Milestone C	U.N.H. Diamond Omar
Quicksilver Magic of Ogston	
Schultz Performing Legend	
S.S. Quicksilver of Fallneva	

¹ Number in parentheses indicates in how many pedigrees the animal occurred as a sire or a maternal grand-sire.

TABLE 3. Activity of uridine monophosphate synthase for 15 Jersey bulls and designation as an elite or control bull.

Bull	Group	UMP synthase
		($\mu\text{g/ml/h}$)
Reliant-ET	Elite	2.74
Schultz Performing Legend	Control	2.85
J.S. Quicksilver Royal	Elite	2.88
Foundation Tyler-ET	Control	2.95
Walebe Nassau-ET	Control	3.08
Mayfield Volunteer	Control	3.09
Renegade	Control	3.10
Highland Magic Duncan	Elite	3.10
Funk Soldier Boy Liberty	Control	3.13
LOF Black Bandit	Control	3.14
Greenwood Saint Apache	Control	3.25
A-Nine Top Brass	Elite	3.27
Walebe Validate-ET	Control	3.46
Yankee FW Chief	Elite	3.52
Palmer Fascinator George	Elite	3.58

searching of the pedigrees indicated that Observer Chocolate Soldier had additive relationship of 1/8 or greater with 13 of the 15 bulls sampled. The 2 bulls not closely related to Observer Chocolate Soldier were half brothers, sons of Shadewell Fascinator.

RESULTS

Because all bulls were considered normal for activity of UMP synthase (Table 3) and the activity of UMP synthase for the elite and control bulls was not significantly different (Table 4), discussion will consider these 15 Jersey bulls together. The basis for finding normal activity may be explained as follows. First, no bull had one-half the activity of

another bull. As Jerseys had not been tested previously, no benchmark of normal activities had been established. One criteria of UMP synthase-deficient heterozygotes among Holsteins was that they had approximately one-half the activity of other bulls. This situation was not found among Jerseys. Second, the Shapiro-Wilk W statistic equaled .95, which was not significantly different from normality (8). This is consistent with all 15 blood samples from a single normally distributed population. This normality in Jerseys is in contrast to Holsteins where activity is bimodal with one mode corresponding to heterozygotes and the other to normals. Third, activity of Jersey bulls was within normal range for Holsteins (1, 3, 4, 6). Fourth, delimiter at 2.1 units activity UMP synthase was less than activities of all Jersey bulls. Delimiter is defined as two-thirds of average of normal individuals (4). Prior to this study, the delimiter had been estimated from Holstein data, and after blood analysis, 2.1 was estimated from two-thirds the average of the 15 Jersey bulls.

Coefficient of variation was less for the Jersey than Holstein bulls because standard deviation and range of activity in Jerseys was less. This may have been a function of the few Jerseys sampled or it could be the influence of a single bull, such as Observer Chocolate

TABLE 4. Summary of UMP synthase for elite and control Jersey bulls.

	Mean	SD	CV
	—($\mu\text{g/ml}$)—		
Elite bulls	3.18	.34	11%
Control bulls	3.12	.17	6%
Overall	3.14	.24	7.7%
Delimiter	2.1		

Soldier, who was related to almost all of the sampled bulls.

CONCLUSION

The fact that these 15 Jersey sires had activities of UMP synthase within normal expectations is insufficient to conclude that the Jersey breed is homozygous for normal activity. However, we can be confident that these sires will not be responsible for embryonic mortality resulting from matings with animals heterozygous for UMP synthase deficiency. These bulls are having a major impact on the Jersey breed, but they are not disseminating the undesirable UMP synthase allele.

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