

氏名	NGUYEN DANG QUI		
授与した学位	博士		
専攻分野の名称	農学		
学位授与番号	博甲第	6283	号
学位授与の日付	2020年 9月25日		
学位授与の要件	環境生命科学研究科 農生命科学専攻 (学位規則第4条第1項該当)		
学位論文の題目	Assessment of milk and gut microbiota of lactating Jersey cows in relation to milk quality and animal health management (ジャージー種乳牛の乳質および健康管理を目的とした乳汁および腸内細菌叢の調査)		
論文審査委員	教授 齋藤 昇	教授 森田 英利	准教授 荒川 健佑
学位論文内容の要旨			
<p>Recently, reconsideration of purebred Jerseys and a crossbreed between Holsteins and Jerseys has been discussed, because Jerseys have fewer reproductive problems than Holsteins. Milk products of Jerseys are featured by high protein and fat contents together with milk yellowness derived from a high amount of β-carotene. These features could become advantage and disadvantage, because bovine milk is an ideal environment for the growth of many microorganisms including both desirable and undesirable ones. Milk microbiota can be related with health of the cows and quality and safety of the milk products; hence, managing factors affecting milk microbiota of Jersey cows were examined in this thesis.</p> <p>In the first experiment, microbiota of individual cow milk, bulk tank milk, and feces of Jersey cows were examined. Samples were collected from two farms (F1 and F2) in cool (Nov) and hot (Jul) seasons, because milk microbiota has been shown to vary by season and farm management. Milk yield and milk composition were similar between the two farms and between the two seasons. Relative abundance of milk microbiota for <i>Pseudomonadaceae</i>, <i>Enterobacteriaceae</i>, and <i>Streptococcaceae</i> (F1 > F2) and <i>Lactobacillaceae</i>, <i>Bifidobacteriaceae</i>, and <i>Cellulomonadaceae</i> (F1 < F2) were different between the two farms, and those for <i>Staphylococcaceae</i>, <i>Bacillaceae</i>, <i>Ruminococcaceae</i>, and <i>Veillonellaceae</i> (Nov < Jul) and <i>Methylobacteriaceae</i> and <i>Moraxellaceae</i> (Nov > Jul) were different between the two seasons. The finding that relative abundance of <i>Pseudomonadaceae</i> and <i>Moraxellaceae</i> appeared greater than those reported for Holstein milk suggested that higher protein and fat content may result in a greater abundance of proteolytic and lipolytic taxa in Jersey cow milk.</p> <p>In the second experiment, a commercial product of β-carotene supplement (ROVIMIX® β-carotene) was provided to about 90 Jersey cows for one month at 1,000 mg/head/day by mixing the supplement with a total mixed ration. Rumen fluid, feces, milk, and blood were collected from 10 randomly selected cows before starting the supplementation, at 2 and 4 weeks after the commencement, and at 2 and 4 weeks after termination of the β-carotene supplementation. The yield and somatic cell count of the milk were decreased and the protein, fat, solid-not-fat, and β-carotene contents were increased when β-carotene was supplemented. The β-carotene supplementation had substantial effect on milk microbiota composition; relative abundances of <i>Ruminococcaceae</i>, <i>Moraxellaceae</i>, and S24-7 were increased, and those of <i>Bacillaceae</i>, <i>Paenibacillaceae</i>, <i>Staphylococcaceae</i>, <i>Aerococcaceae</i>, <i>Lactobacillaceae</i>, and <i>Streptococcaceae</i> were decreased. Milk β-carotene content was positively correlated with <i>Erysipelotrichaceae</i> and <i>Ruminococcaceae</i>, and negatively correlated with <i>Aerococcaceae</i>, <i>Lactobacillaceae</i>, and <i>Staphylococcaceae</i>. These changes could support the fact that Jersey cows have less opportunity of mastitis infection.</p> <p>Compared to the milk microbiota of Holstein cows examined in previous studies, the milk microbiota of Jersey cows showed greater diversity, higher abundance of <i>Lactobacillaceae</i>, and lower abundance of <i>Staphylococcaceae</i>. These differences can be related with high contents of protein, fat, and β-carotene contents of the Jersey milk; hence, methods for milk microbiota and herd management should be explored while considering breed difference between Holsteins and Jerseys.</p>			

論文審査結果の要旨

ジャージー種はホルスタイン種より乳量が3割程度少ないが、タンパク質や脂肪含量は逆に4割程度高い特徴的な牛乳を生産する。乳量が少ないことは経営上の弱点であるが、繁殖障害や乳房炎に罹患する頻度が低いことから、ジャージー種の有用性が近年世界的に評価されている。しかし、ホルスタイン種に比べジャージー種に関する情報はきわめて乏しい。本研究では、ジャージー種乳牛の乳質および健康管理法の高度化を目的として、乳汁細菌叢、腸内細菌叢および血液性状に関する実態調査を行った。

実験1では、乳質の異なる2軒の農場を訪問し、乳汁、糞便、尾静脈血、牛舎環境サンプルの採材を行った。冬期および夏期にサンプリングを行い、乳量、乳質と関連した乳汁細菌叢、糞便細菌叢および血液性状の差異および変動について検討した。乳量、乳成分は2農場で似かよっていたが、血液性状は農家間で明確な違いがあり、血漿および乳汁β-カロテン濃度が高い農家の牛群は、エネルギーバランスおよび肝機能がより好ましい状態にあった。乳汁細菌叢にも違いが認められ、栄養・健康管理法の改善が乳汁細菌叢の制御にもつながることが示された。

実験2では、実験1とは別の農家で約90頭を対象としたβ-カロテンの給与試験を行った。秋期から冬期にかけて採材を繰り返し、乳汁、第一胃内容物および糞便の細菌叢ならびに血液性状の変化を調べた。β-カロテンの給与は血漿および乳汁β-カロテン濃度を高め、乳汁中の*Staphylococcaceae*, *Streptococcaceae*, *Corynebacteriaceae*等を減少させた。実験1で見られた血液性状の差異を確認することはできなかったが、ジャージー種は乳房炎の罹患率が低いという事実を説明する興味深い新しい知見が得られた。

実態調査をもとに、ジャージー種乳牛の飼養管理法改善に向けた科学的情報を数多く示した意義は大きい。よって、NGUYEN Dang Qui氏は博士（農学）の学位を授与される資格があると判断した。