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授与した学位	博士		
専攻分野の名称	農学		
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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	Microbiological studies on constraints and opportunities of dairy cattle production in Vietnam (ベトナム酪農の制限要因及び発展性に関する微生物学的研究)		
論文審査委員	教授 齋藤 昇	教授 舟橋 弘晃	教授 西野 直樹
<b>学位論文内容の概要</b>			
<p>Hot and humid climates have negative impacts on productivity of dairy cows, especially for high-yielding and improved breeds. Nevertheless, the population of dairy cows in Vietnam has increased at an annual rate of about 10% in the last decade. Average milk yield per cow is as low as 4,600 kg per year; hence, dairy industry of Vietnam still has a large room for improvement in productivity. In this thesis, four microbiology based experiments were carried out to examine potentials, limitations, and prospects of dairy cattle production in Vietnam. Topics include forages and by-products utilization, feeding and nutrition, and farm management in relation to mastitis and endometritis prevention.</p> <p>In the first experiment, fermentation characteristics and aerobic stability of total mixed ration (TMR) silage, prepared and preserved in Hue, was examined. All the silages were well preserved, with lactic acid serving as the major preservative, but aerobic stability was not secured when corn stover was used as a TMR ingredient. In aerobically unstable silage, bands indicative of <i>Acetobacter pasteurianus</i>, <i>Staphylococcus</i> sp., and <i>Streptomyces</i> sp. were specifically observed.</p> <p>In the second experiment, direct-cut and wilted elephant grass silages were prepared in Hue, with and without a mixture of <i>Lactobacillus paracasei</i> and <i>Lactococcus lactis</i> (LP+LC) or <i>Lactobacillus buchneri</i> (LB). Acetate was predominantly produced during the fermentation of control and LB-inoculated silages, whereas the content was not sufficient to inhibit aerobic spoilage for 7 days. LP+LC inoculation greatly enhanced lactate content, and did not improve aerobic stability or decrease the total fungal population.</p> <p>In the third experiment, a practical survey of fecal microbiota was performed by visiting 12 small-scale dairy farms at three regions, i.e. Tay Ninh, Tien Giang, and Lam Dong. The populations of total bacteria and <i>Bacteroides-Prevotella-Polyphyromonas</i> group were stable regardless of the regions. Cows in Lam Dong, where climate is similar to temperate and good milk performance is shown, had higher <i>Ruminococcus albus</i> and <i>Lactobacillus</i> populations than cows in Tay Ninh and Tien Giang.</p> <p>In the fourth experiment, the relationship between the fecal, milk, uterine, airborne dust, and water microbiota in dairy farms was evaluated. Two sets of airborne dust and water samples from the cowshed and six sets of fecal, milk, and uterine samples from dairy cows were collected from two farms in Ho Chi Minh City at 20-40 days postpartum. The predominant species in the fecal microbiota was not as predominant in the milk microbiota, but occasionally appeared in the uterine microbiota. The microbiota from the airborne dust and water samples did not show a relation with either the milk. The farm-to-farm difference was more apparent for the milk microbiota than for the fecal and uterine microbiota.</p> <p>In conclusion, although acetic or alcoholic fermentation can take place in grass and by-products ensiling, desirable lactic acid fermentation with acceptable aerobic stability may be obtained if preserved as TMRs. Based on practical survey of fecal microbiota, a high productivity in Lam Dong farms could be due to increased populations of <i>Ruminococcus albus</i> and <i>Lactobacillus</i> group. Because the predominant species in the fecal microbiota was not as predominant in the milk microbiota and occasionally appeared in the uterine microbiota, further cares need to be provided to avoid fecal microbiota contamination with the uterus microbiota to improve fertility.</p>			

## 論文審査結果の要旨

高温多湿という熱帯地域の気候は乳牛の生産性を著しく制限するが、経済発展が続くベトナムでは乳牛の頭数が年率 10%程度で増加している。平均泌乳量は 4,600kg/年と冷涼地域の 1/2 程度であり、飼料、栄養、管理、衛生のいずれにも課題があると考えられるが、それらに関する情報は乏しい。TRAN Thi Minh Tu 氏は、上記の課題について実態調査を中心に研究を行った。

最初の実験では、牧草、農業副産物及び食品副産物の発酵貯蔵に関して、中部フエで現地調査を行った。熱帯で牧草を発酵貯蔵すると乳酸よりも酢酸が優勢となりやすいが、*Lactobacillus buchneri* がこの酢酸生成に関与することが明らかとなった。また、数種の食品副産物と稲わらを混合して発酵貯蔵すると、乳酸生成が促進されるとともに、*Acetobacter pasteurianus*, *Staphylococcus* sp. 及び *Streptomyces* sp. が抑制されて、開封後の変敗が遅延することが示された。

続く実験では、Tay Ninh, Tien Giang 及び Lam Dong 省の計 12 農場を訪問し、泌乳牛から糞便を採取して腸内細菌叢を調べた。ベトナムでは冷涼な Lam Dong 省の乳牛は Tay Ninh 及び Tien Giang 省の乳牛より 2 倍程度の泌乳量を示し、*Ruminococcus albus* 及び *Lactobacillus* spp. の菌数が高かった。Tay Ninh 及び Tien Giang 省の乳牛は、農場に関わらず似かよった腸内細菌叢を示した。

最後の実験では、ホーチミン市で大規模経営を行う 2 農場を訪問し、糞便、乳汁、子宮内膜、空気粉塵及び水を採取して細菌叢を MiSeq で解析した。糞便の細菌叢と乳汁のそれは大きく異なっており、調査した 2 農場では糞便の汚染は十分回避されていた。子宮内膜の細菌叢と糞便のそれには一部で重なりがあったが、受精及び妊娠の遅れと子宮内膜の細菌汚染は必ずしも関連していなかった。空気粉塵及び水の細菌叢は似通っており、糞便、乳汁、子宮内膜のいずれとも関連は乏しかった。

これらの知見は、農業副産物と食品副産物を現状以上に活用できる飼料調製技術があること、泌乳量の増加には Lam Dong 省で行われている飼料配合が参考になること、乳房炎や子宮内膜炎の多発は糞便細菌の汚染以外の要因が関わっていることを示している。現地での調査研究に基づいた情報は実用面での価値も高く、TRAN Thi Minh Tu 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。