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# Influence of Orally Fed Probiotics on the Performance of Crossbred Lactating Dairy Goats

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## Abstract
The study was conducted to investigate the influence of orally fed probiotics on the performance of crossbred lactating dairy goats diagnosed with elevated somatic cell counts. A total of sixteen crossbreed Anglo-Nubian x Saanen dairy goats on early to mid-lactation diagnosed with subclinical mastitis were randomly assigned into four treatments orally fed with 6ml of $5x10^9$ cfu/ml probiotic feed supplements for 8 weeks. Treatments were: control -without probiotic supplements (T1), Lactic acid bacteria (T2), *Yeast culture (T3)*, and multi-strain probiotic *(T4)*. Daily ration was composed of 1kg concentrate mixed-feed (*Leucaena leucocephala* dried leaves and pollard), and 4 kg (50:50) fresh *Pennisetum purpureum* and *Gliciridia sepium* leaves. All the data gathered were processed and analyzed using SPSS version 20. The analysis of variance revealed that probiotic-treated groups had significantly ($P \leq 0.05$) higher milk yield and lower somatic cell counts compared to the control group. Milk components such as milk fat yield, protein, and lactose were not significantly affected by probiotic feeding except for solid-not-fat yield. The study suggests that strains of lactic acid bacteria and multi-strain probiotics can be good supplements for dairy goats with subclinical mastitis.

## 1. Introduction

In recent decades, dairy goat production systems have evolved towards an intensification level that is not always accompanied by improved facilities or better handling and milking routine. This has led to an increase in intra-mammary infections (IMI) and a worsening of milk quality and decreased milk yield. Bacterial infection in dairy goats which usually results in elevated somatic cell counts (SCC) appears to have much greater magnitude in income loss compared to dairy cows due to decreased milk yield [15].

For many years, antibiotics and many other chemicals has been tried to ruminants as treatments to intra-mammary infections. But due to contamination of milk caused by medication, extra labour required, high cost of veterinary care and medicines, famers usually opted culling the animals. Recently, microbial and fungal probiotics are being explored as alternative of antibiotic feed additives that improve gut health and promote animal performance. These live microbial supplements are called probiotics which beneficially affects the host animals by improving its intestinal microbial balance [7].

These products do not leave residues in animal products and promote animal performance and health [6, 7, 11, 20, 30], because they improve diet digestibility [2], resulting in better nutrient utilization and consequently, higher productivity [13, 18].

The positive effects of probiotics on milk production and composition have been recently reported [3, 25, 28, 16, and 9]. However, very limited data were available on the performance of lactating dairy goats. Thus, the present study was conducted to investigate the influence of orally fed probiotics on the performance of crossbred lactating dairy goats diagnosed with elevated somatic cell counts.

## 2. Material and Methods

### 2.1. Experimental Animals and Distribution

The experiment was conducted in Naawan Agricultural Development Center (NADC) Goat Project, Naawan, Misamis Oriental. A total of sixteen (16) crossbred Anglo-Nubian X Saanen lactating dairy goats on early to mid-lactation, ranging from 35 to 40 kg, diagnosed with elevated somatic cell counts were randomly distributed into four treatments: T1 – control (without probiotic supplements); T2-lactic acid bacteria (*P. acidilactici 3G3, L. plantarum BS*); T3 – 6ml *S. cerevisiae 2030*; T4 – multi-strain probiotics (*P. acidilactici 3G3, L. plantarum BS, S. cerevisiae 2030*). Using a disposable plastic syringe, 6ml of $5x10^9$ cfu/ml probiotic fed supplements were orally fed for 8 weeks. Throughout the feeding trial experimental animals were individually fed daily with 4kg (50:50) fresh cut *Pennisetum purpureum* and *Gliciridia sepium* leavesand 1kg mixed concentrate feed (dried *Leucaena leucocephala* leaves and pollard) with free access to fresh and clean water. Fresh grasses and leaves were offered every 0900H, while mixed concentrate feed was offered 1300H. Proximate analyses of feed used are presented in Table 1.

***Table 1.*** *Proximate Analysis of Dairy Goats' Diet.*

| CONTENTS % | NAPIER GRASS | MADRE DE CACAO LEAVES | MIXED IPIL-IPIL LEAVES & POLLARD |
|---|---|---|---|
| Moisture | 3.90 | 4.31 | 11.06 |
| Dry matter | 96.10 | 95.69 | 88.94 |
| Ash | 14.44 | 8.19 | 6.30 |
| Crude Protein | 11.26 | 20.08 | 15.35 |
| Crude Fiber | 31.68 | 20.06 | 2.57 |
| Crude Fat | 1.85 | 6.59 | 49.28 |
| Nitrogen Free Extract | 36.87 | 40.77 | 1.14 |
| Calcium | 0.02 | 1.45 | 1.14 |
| Phosphorus | 0.62 | 0.33 | 0.62 |

Analyzed at Lipa quality control center, Lipa, Batangas, Philippines

### 2.2. Composition and Production of Probiotics

Probiotic feed supplements were produced in a large scale using coconut paring meal extract and coconut water as base substrate and nutrient source. The optimized specific parameters for *Lb. plantarum BS* and *P. acidilactici 3G3* and *S. cerevisiae 2030* are shown on Table 2.

***Table 2.*** *Optimized Specific Parameters for Probiotic Supplements.*

| Parameters | *L. plantarum BS* | *P. acidilactici 3G3* | *S. cerevisiae 2030* |
|---|---|---|---|
| Coco paring meal extract | 8.38% | 40% | - |
| Coconut water | 83.85% | 50% | 25% |
| Molasses | 2% | 0.50% | 20% |
| $(NH_4)_2SO_4$ | - | - | 0.52% |
| Yeast Extract | 0.50% | 0.50% | - |
| $K_2HPO_4$ | 0.20% | 2.% | 0.15% |
| Trisodium citrate | 0.20% | 0.20% | 0.06% |
| $MnSO_4$ | 0.10% | 0.20% | 3.91% |
| $MgSO_4$ | 0.02% | 0.05% | - |
| Tween 80 | 0.10% | 0.02% | - |
| Sodium Acetate | 0.50% | 0.10% | - |
| Incubation Period | 37°C for 24 hrs | 37°C for 24 hrs | 30°C at 20-24 hrs |
| Agitation speed | - | - | 100-125 rpm |

Four (4) ml of each medium for a specific culture was produced and sterilized at 15 psi (121°C) for 15 minutes and stored at room temperature prior to inoculation. About 3 to 5% of the cultures *Lb. plantarum BS, P. acidilactici 3G3* and *S. cerevisiae 2030* were inoculated into the specified medium and incubated at 37°C for 24 hours and 30°C for 20 to 24 hours, respectively. Afterwards, the produced probiotic feed supplements were dispensed into sterile plastic containers according to treatments: $T_1$ –50% *Lb. plantarum BS* and 50% *P. acidilactici 3G3*; $T_2$ – 100% *S. cerevisiae 2030*; $T_3$ – 33% *Lb. plantarum BS*, 33% *P. acidilactici 3G3*, and 33% *S. cerevisiae 2030*.

### 2.3. Data Collection and Analyses

Milking was conducted once daily every 8:00 A.M where in experimental animals had free accessed in urea molasses mineral salt block (UMMB). Prior to milking, somatic cell test was conducted and the severity of infection was scored and analyzed based on CMT reading described by Ruegg, P. L (2005).

Milk yield collected from each of the experimental animals were weighed and recorded daily. Seven (7) ml composite milk samples were collected once a week for the analyses of fat, protein, lactose and solid-non-fat using milk sonic analyzer machine.

### 2.4. Statistical Analysis

Analysis of Variance in Randomized Complete Block Design (RCBD) was used in determining the significant result of the different factors. Differences among treatment means were determined using Least Significant Difference (LSD). All data obtained from the study were processed and analyzed using SPSS version 20 with homogeneity of variance tested using Levene's Test.

## 3. Result and Discussion

### 3.1. Influence on Somatic Cell Counts

Figures 1a & 1b show the comparison of on-farm or indirect somatic cell counts (SCCs) from four experimental treatments during the 8 weeks experimental feeding trial.

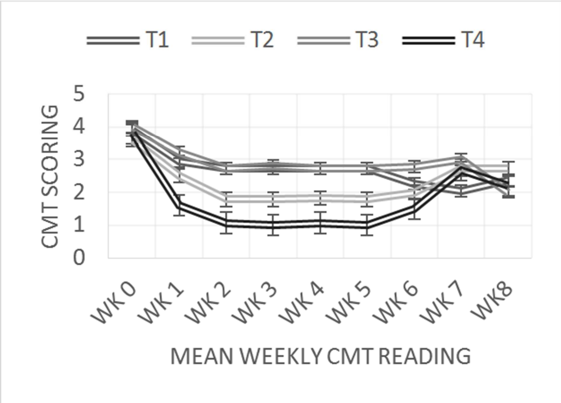


***Figure 1a.*** *Somatic Cell Reading (Right teats) of lactating goats.*

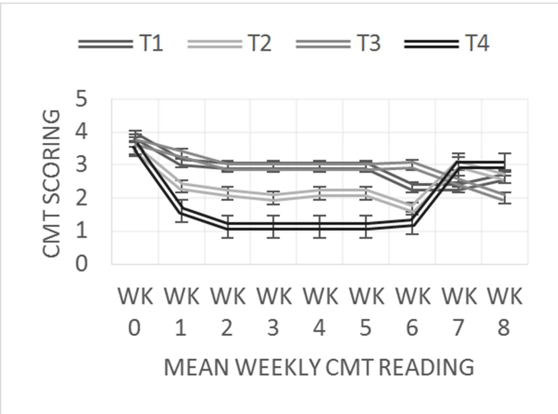


***Figure 1b.*** *Somatic cell Reading (Left teats) of lactating goats.*

Result of the Analysis of Variance showed significant (P≤0.05) differences between the treatment groups in terms of indirect somatic cell counts for both left (P≤0.035) and right teats (P≤0.028). During the first six weeks of experimentation, multi-strain probiotic supplements showed the lowest SCC counts from both teats of the lactating goats among the treatment groups. These conform to the findings of [10], which showed significant (P≤0.05) reduction of subclinical mastitis incidence on cows after treatment (intra-vaginal) with lactobacilli strains. The observation was similarly reported in 25 bovine mastitis cases. In which 18 out of 25 cattle treated with *Lc. lactis DPC3147 obtained lower the somatic cell counts and did* not exhibit clinical signs of disease following the treatment [24]. Furthermore, a total of 21.7% cured cows with elevated somatic cell counts were reported after treatment of lactic acid bacteria [8]. In the present study, multi-strain probiotic and strains of lactic acid bacteria showed very good performance in reducing somatic cell counts compared to *S. cerevisiae* and the control. The administration of lactobacilli and their distribution in the digestive tract positively influenced the reduction of pathogens in the mammary gland. Family of lactic acid bacteria are known to produce bacteriocins which can inhibit a broad spectrum of gram-positive bacteria. Their ability to produce toxic metabolites such as lactic acid, hydrogen peroxide ($H_2O_2$) and bacteriocins has been suggested to inhibit other bacteria [12] which may include mastitis-causing bacteria such as streptococci and staphylococci [24].

### 3.2. Influence on Milk Yield

In terms of milk yield, highly significant (P≤0.05) differences was found between the probiotic fed groups of lactating goat and the control (shown in Figure 2).

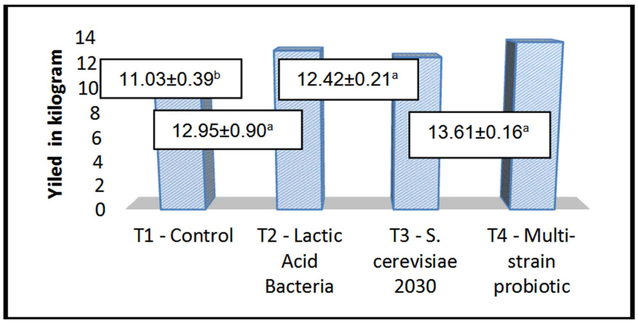


***Figure 2.*** *Total milk yields of crossbred lactating dairy goats orally fed with probiotics.*

Multi-strain probiotics (T4) showed the highest milk yield among the treatment groups fed with probiotics. However, no significant differences were found between the milk yields of lactating goats orally fed with probiotics. The control group, on the other hand, had significantly (P≤0.05) lower milk yield than the probiotic-fed groups. Significant increase in milk yield associated with probiotic feeding has been previously reported in dairy goats [22, 26] and in dairy ewes [16, 17]. Improved milk production observed from the probiotic-treated groups compared to control can be assumed as the result of improved host immune-modulation provided by the lactic acid bacteria [22], increased microbial activity, microbial protein flow, and efficient utilization of starch from the feed modulated by *S. cerevisiae* inside the rumen [4] resulting to higher production of milk.

### 3.3. Influence on Milk Components

The total fat yield, protein, and solid-non-fat (SNF) of crossbred lactating goat orally fed with probiotics are summarized in Table 3.

***Table 3.*** *Total Fat yield, Protein, and solid-non-fat of crossbred lactating goats orally fed with probiotics.*

| TREATMENTS | Fat | Protein | SNF |
|---|---|---|---|
| $T_1$ - Control | 6.12±0.62 | 3.91±0.31 | 8.95±0.54$^b$ |
| $T_2$ – *Lactic acid bacteria* | 7.63±0.45 | 4.54±0.24 | 11.06±0.62$^a$ |
| $T_3$ - *S. cerevisiae 2030* | 7.69±0.10 | 4.64±0.26 | 10.67±0.31$^a$ |
| $T_4$ - Multi-strain (mixed $T_2$ & $T_3$) | 7.47±0.40 | 4.79±0.27 | 10.39±0.23$^a$ |

Values on the same vertical columns followed with different letters are significantly different based on LSD at P≤0.05.

No significant differences were found between the treatment groups in terms of milk fat yield and milk protein yield (P>0.05). These results agree with the research findings conducted on goats [12], on ewes [16], and on cows [21]. In contrast, significant increase in milk fat and protein content in dairy cows fed with yeast culture was previously reported by several authors [19, 5, and 1].

Significant differences (P≤0.031) between the solid non-fat milk yield of the treatment groups based on ANOVA indicates that the probiotic treatments had significantly higher SNF yield compared with the control group but no significant differences between the SNF yields of the probiotic-treated groups. Similar result was also observed in crossbred dairy cows supplemented with multi-strain probiotics [27, 29]. However, decreased protein yield and fat on cows treated (intra-vaginal) with the mixture of lactic acid bacteria was also reported [10]. Significant increase in solid-non-fat yield observed from microbial-treated groups in the current study can be reflected in the increase of protein and fat yield observed from microbial-treated groups (though non-significant) as the product of enhanced nutrient supply in the mammary gland through increased rumen activity and microbial protein flow created by probiotics inside the rumen.

## 4. Conclusion

The findings suggest, based on the experimental condition, that oral probiotic supplements used in this study could be used as an alternative for antibiotics in lowering somatic cell counts and in enhancing the yield and milk components of lactating dairy goats.

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