Milk Production Response of Dairy Cattle Supplemented with Amaferm

Alex Bach
IRTA-Dairy Systems
alex.bach@irta.es

1 Introduction

Feeding *Aspergillus oryzae* fermentation extracts can increase milk yield (Harris et al., 1983, Gomez-Alarcon, 1991). Usually, response to *Aspergillus oryzae* is more evident at the beginning of lactation (Kellems et al., 1987) than in later stages. Milk composition is usually not affected (Kellems et al., 1990; Gomez-Alarcon, 1990; Denigan et al., 1992) with *Aspergillus oryzae* supplementation, with one reported exception (Higginbotham et al., 1993) describing an increase in both milk and protein percentages.

2 Materials and Methods

A total of 40 lactating dairy cows were blocked by days in milk and level of production into three different treatments and a control group. All four groups received the same ration (Table 1) once daily. There were three groups that were supplemented with 3, 30 and 60 g/d with Amaferm for 102 days. Amaferm was individually hand-fed to dairy cattle daily. Feces, blood, and milk samples from the 30 animals receiving Amaferm were collected biweekly and frozen for later determinations as dictated by European comission analyzing the data for registering Amaferm. A veterinarian conducted a weekly check-up of the animals to monitor and record their health status (basically assessing fever, mastitis, metritis, and lameness). Animals were milked twice a day. Milk production was recorded daily and milk composition monthly.

Average milk production of the different groups at the beginning of the experiment was: 33.0, 32.9, 32.3, and 33.1 kg/d for Control, Amaferm 3g, Amaferm 30g, and Amaferm 60g, respectively. The data were analyzed as a factorial design using the average milk production during the month before the beginning of the trial as a covariate. The use of a covariate greatly improves the precison of the data analysis. The analysis of a covariance involves adjusting the observed response variable (milk production) for the effect of a concomittant variable (former milk production) that could inflate the error mean square and make true differences among treatments harder to detect. Thus, the analysis of covariance is a method of adjusting the effects of an uncontrollable nuissance variable such as the milk production level of the animals during the 30 days prior the beginning of the treaments. The valures reported in the tables are sum square means adjusted for the covariate, and they are different that the actual average of milk prodution, because former milk production is taking into account to calculate the sum square means. Milk production after treatment is dependent (to some extend) to the former level of production. The covariate analysis will remove the dependence when separating the effects of the Amaferm supplementation. The 100 days of test were divided into 3 periods (in groups of 30 days). The remaining 10 days of experiment (required for EU registration purposes) were not included in the analyses. The general linear model used was:

$$Dependentvariable = Covariate + Period + Treatment + PeriodxTreatment + \varepsilon \quad (1)$$

Averages were separated using the LSD method and considering the significance level at $P < 0.05$. Mean separation among treaments was conducted using the Least Square Difference method.

Table 1. Ingredient and nutrient composition of the basal ration.

Ingredient	Composition (% of DM)
Corn, grain	24.4
Rye grass, silage	17.7
Wheat, silage	14.5
Soybean, meal	11.1
Alfalfa, silage	10.6
Citrus, pulp	7.7
Corn gluten feed	4.8
Lupine, meal	4.0
Cottonseed, whole	.2
Barley, grain	2
Vitamin/minerals	0.9
Salt	0.3
Nutrient	**Composition**
Crude protein, %	17.3
Ether extract, %	4.2
Neutral detergent fiber, %	33.3
Acid detergent fiber, %	22.0
Nonfiber carbohydrates[a], %	37.7
NEl[b], Mcal/kg	1.53

[a] NFC: Nonfiber carbohydrates corrected for the N content of NDF.

[b] NEl calculated at 3.68 times above maintenance (corresponding to a dry matter intake of 22.2 kg/d.

3 Results and Discussion

The statistical model yielded solid results and Figure 1 shows how the distribution of residuals and the observed vs predicted values were appropriate and acceptable. The evolution of milk production before and after the beginning of the treatments is shown in Figure 2. After the beginning of the experiment all cows seemed to do better than the former month (milk persistency increased). However, cows supplemented with Amaferm seemed to show a lower milk drop as days in milk (**DIM**) increased. Cows receiving the Amaferm 30g treatment started the study with lower milk productions than the rest of treatments and their production remained low throughout the study, except towards the end of the experiment.

Table 2. Rectal temperatures (sum of square means) of cows depeding on the treatment received.

Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Control	38.7[a]	.048	38.6	38.8
Amaferm 3g	38.7[b]	.046	38.6	38.8
Amaferm 30g	38.6[c]	.046	38.5	38.7
Amaferm 60g	38.7[c]	.046	38.6	38.8

There were no health disorders and average rectal temperature was not significantly affected by period nor treatments, averaging 38.7 C across the whole experiment (Table 2). As the experiment progressed, DIM increased ($P < 0.05$) and milk production decreased ($P < 0.05$) as it was expected (Tables 3 and 4).

Table 5 shows that Amaferm supplementation significantly ($P < 0.05$) increased milk production across treatments. The highest response was obtained with 3 g/d of Amaferm. The supplementation of 30 or 60 g/d of Amaferm increased milk production with respect the Control treatment, but the response was lower ($P < 0.05$) than the obtained with the 3 g/d.

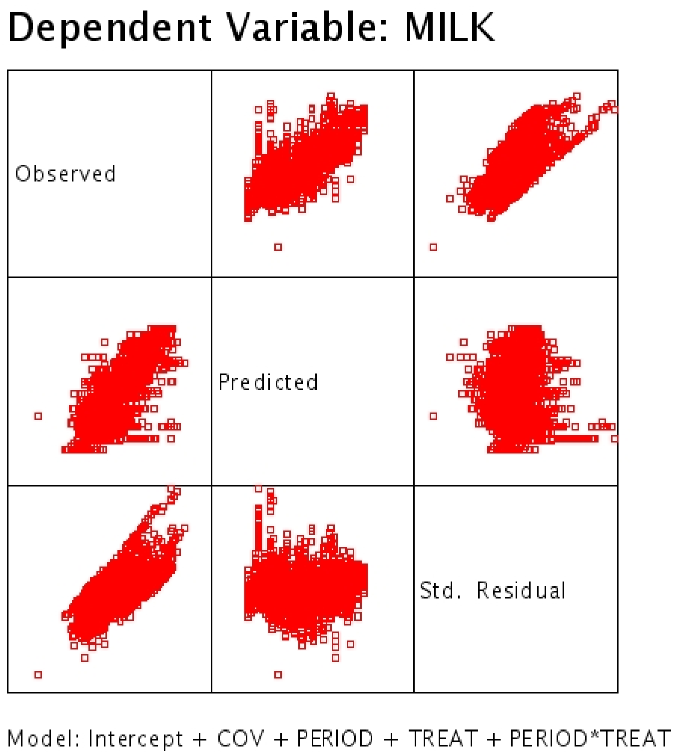

Figure 1: Distribution of the residuals obtained with the statistical model used for analyzing the data

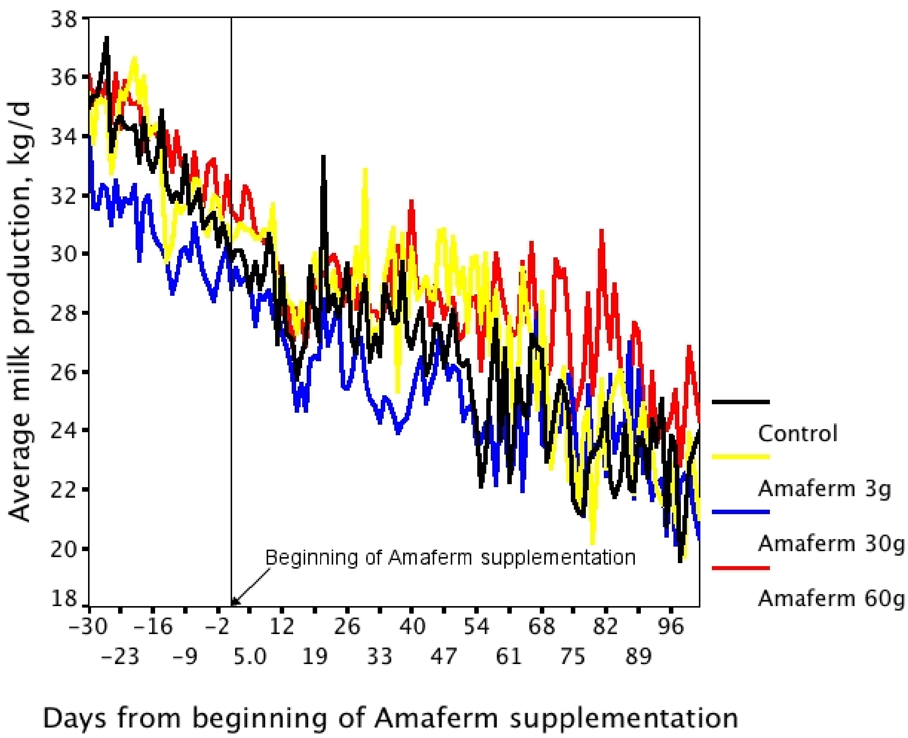

Figure 2: Daily average milk production of the four groups of cows from 30 days before until 102 days after Amaferm supplementation

Table 3. Milk production (sum of square means) across the three 30-d periods.

Period	Mean	Std. Error	Lower Bound	Upper Bound
1	29.02^{a}	.138	28.75	29.30
2	27.23^{b}	.139	26.96	27.51
3	25.28^{c}	.151	24.98	25.58

^{a,b,c} Different superscripts indicate significant differences ($P < 0.05$).

Values are sum of square means adjusted for the covariate corresponding to initial milk production (32.8).

Actual milk production averages (not accounting for former level of production) were 28.93, 27.16, and 25.59 kg/d for periods 1, 2 and 3, respectively.

Table 4. Days in milk (sum of square means) across the three 30-d periods.

Period	Mean	Std. Error	Lower Bound	Upper Bound
1	214^{a}	2.79	208	219
2	244^{b}	2.79	239	250
3	273^{c}	2.79	268	279

^{a,b,c} Different superscripts indicate significant differences ($P < 0.05$).

Table 5. Milk production (sum of square means) of dairy cattle as influenced by Amaferm supplementation.

Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Control	26.03^{a}	.167	25.71	26.36
Amaferm 3g	28.52^{b}	.161	28.21	28.84
Amaferm 30g	26.96^{c}	.165	26.64	27.29
Amaferm 60g	27.21^{c}	.169	26.87	27.54

^{a,b,c} Different superscripts indicate significant differences ($P < 0.05$).

Values are sum of square means adjusted for the covariate corresponding to initial milk production (32.8).

Actual milk production averages (not accounting for former level of production) were 26.48, 28.15, 25.79, and 28.49 kg/d for Control, Amaferm 3g, Amaferm 30g, and Amaferm 60g, respectively.

Days in milk were similar across all treatments, however, there were significant differences ($P < 0.05$) between the control group and Amaferm 60g with the Amaferm 3g and 30g (Table 6). These differences might explain why the 60 g/d supplementation did worse than the 3 g/d supplementation, but still, the reason why the 30 g/d supplementation performed worse than the 3 g/d supplementation could not be explained. Furthermore, the inclusion of the initial level of production as a covariate in the statistical analysis helps in removing the noise due to different days in milk and initial level of production, among the different groups of animals.

Table 6. Days in milk (sum of square means) across the four treatments.

Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Control	250^{a}	3.35	244	257
Amaferm 3g	237^{b}	3.18	230	243
Amaferm 30g	239^{b}	3.20	232	245
Amaferm 60g	249^{a}	3.18	243	255

^{a,b} Different superscripts indicate significant differences ($P < 0.05$).

Another possible reason for explaining the lower performance with Amaferm 30g and 60g could have been the milk components produced in milk. However, milk fat percentage was not significantly affected by treatments averaging 3.46, 3.70, 3.56, 3.76% for the Control, Amaferm 3g, Amaferm 30g, and Amaferm 60g treatments, respectively. Similarly, milk protein content was not affected by treatment, averaging 3.53, 3.44, 3.38 and 3.5% for the Control, Amaferm 3g, Amaferm 30g, and Amaferm 60g treatments, respectively.

Despite the lack of significant differences in milk fat percentage among treatments, and due to the combination of a numerically higher milk fat percentage and a significantly greater milk production, fat corrected milk yield was significantly affected by treatments (Table 7).

Table 7. Fat corrected milk yield (sum of square means) as affected by Amaferm supplementation.

Treatment	Mean
Control	24.32^a
Amaferm 3g	26.64^b
Amaferm 30g	25.34^c
Amaferm 60g	26.19^b

^{a,b,c} Different superscripts indicate significant differences ($P < 0.05$).
Values are sum of square means adjusted for the covariate corresponding to initial milk production (32.8).

Actual fat corrected milk production averages (not accounting for former level of production) were 24.22, 26.97, 23.94, and 27.46 kg/d for Control, Amaferm 3g, Amaferm 30g, and Amaferm 60g, respectively.

4 Conclusions

The results from this study indicate that Amaferm can effectively improve milk persistency in dairy cattle and that doses as high as 30 or 60 g/d do not appear to cause any negative effect to dairy cows. There are, however, some unexplained observations, such as the lower improvement in milk production observed with 30 and 60 g/d of Amaferm compared with 3 g/d. As previously observed in other studies, Amaferm supplementation did not affect milk composition.

Amaferm supplementation did not modify rectal temperatures, even at the dose of 60 g/d.

5 References

- Denigan, M. E., J. T. Huber, G. Alhadhrami, and A. Al-dehneh. 1992. Influence of feeding varying levels of Amaferm on performance of lactating dairy cows. J. Dairy Sci. 75:1616.
- Gomez-Alarcon, R. A., J. T. Huber, g. E. higginbotham, F. Wiersma, D. Ammon, and B. Taylor. 1991. Influence of feeding *Aspergillus oryzae* fermentation extract on the milk yields, eating patterns, ad body temperatures of lactating cows. J. Anim. Sci. 69:1733.
- Harris, B., H. H. Van Horn, K. E. Manookian, S. P. Marshall, M. J. Taylor, and C. J. Wilcox. 1983. Sugarcane silage, sodium hydroxide- ad steam pressure-treated sugarcane bagasse, corn silage, cottonseed hulls, sodium bicarbonate, and *Aspergillus oryzae* product in complete rations for lactating cows. J. Dairy Sci. 66:1474.
- Higginbotham, G. E., D. L. Bath, and L. J. Butler. 1993. Effect of feeding an *Aspergillus oryzae* extract on milk production and related response in a commercial dairy herd. J. Dairy Sci. 76:1484.
- Kellems, R. O., A. Lagerstedt, and M. V. Wallentine. 1990. Effect of feeding *Aspergillus oryzae* fermentation extract plus yeast culture plus mineral and vitamin supplement on performance of Holstein cows during a complete lactation. J. Dairy Sci. 73:2922.

6 Legal Note