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# Performance of Pre and Post-Partum Weather Stressed Cows Supplemented with Yeast Culture

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# PERFORMANCE OF PRE AND POST-PARTUM WEATHER STRESSED COWS SUPPLEMENTED WITH YEAST CULTURE

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SUPPLEMENTED WITH YEAST CULTURE

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# DEDICATION

I dedicate this thesis to my father, mother, and sister who helped me and taught me the value of life, hard work, and effort. Thank you for giving me my love for animals and environment, but most of all for your devotion and understanding, especially in those difficult times. To my friends and girlfriend that help me through all my education, this thesis, and the adaptation process in the United States, a special thanks.

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Western Yeast Company – Thanks for making me part of your time and making this research possible.

To all the faculty and staff of the Department of Agriculture.

Have the conviction that your work is the most noble that exists.

People can forge metal, raise animals, cultivate plants, extract minerals of the earth; but helping in the intellectual and professional growth of a person is something incomparably delicate, almost always undefined, recognized few times; but those elements make more valuable your profession and job, thank you.

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PERFORMANCE OF PRE AND POST-PARTUM WEATHER STRESSED COWS SUPPLEMENTED WITH YEAST CULTURE

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Directed by: Jenks S. Britt, Elmer Gray, and Jack Rudolph

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Livestock have been fed yeast as a feed supplement for more than 100 years (Stone, C. 00). Yeast is a microscopic, single cell fungi of the plant kingdom. Of the 50,000 species of fungi, only 60 different genera of yeast representing about 500 different species exist. A few of these are used commercially in the animal feed industry as active dry yeast or yeast culture (Kreger, van Rij, 1984).

Yeast culture consists of live yeast cells, plus the medium on which yeast is grown. Yeast products are commonly fed as pro-biotics, but little is known about their effects. Some studies have reported that yeast products increased milk yield and milk fat percentage; however, other studies found that yeast products had no effect on any of these factors (Middelveld. H 1998).

A three phase trial, starting August 2003 and ending February 2005, was conducted at the Western Kentucky University Agricultural Research and Education Complex (Dairy facilities), in Bowling Green, Kentucky. Trial 1 evaluated the affect of dietary yeast, (WY) [a], fed to cows in early lactation during heat stress conditions. Trial 2 evaluated the effect of dietary yeast WY fed to pre and post-partum cows during weather stress conditions. Trial 3 evaluated milk yield of cows fed post-partum cows 2 different

[a] Western Yeast 2x-2-2-2 +., Western Yeast Co., Inc. Chillicothe, IL. 2002

types of yeast, (CC5)[b] or (YS)[c], versus a no yeast control group (CG)[d], during weather stress conditions to post-partum cows. Cows in trials 1 and 2 were fed a total mixed ration (TMRs) consisting of corn silage, alfalfa hay and haylage, grain mix, whole cottonseed and controlled access to alfalfa pasture; while the third trial cows received a TMR of corn silage, alfalfa hay, whole cottonseed and grain mix.

In all trials, milk weights were captured and recorded at each milking using electronic weigh meters, which download into a computer. Seven day average milk weights were used for the analysis in all the trials. Data were analyzed using SPSS 13 and Microsoft Excel XP 2006, standard statistical analysis software.

In trial one milk yield and energy corrected milk (ECM) were statistically higher ($p<0.05$) in the Holstein WY group. The limited Jersey sample size did not provide adequate statistical data for analysis.

In the second trial, milk yield and ECM were statistically higher in the Jerseys in trial WY versus the Jerseys in the CG group. There was no significant statistical difference in Holsteins treated WY versus the Holsteins in the CG group.

In the third trial, ECM was statistically significant at ($p= 0.05$) in the CC5 groups versus the CG group. The CC5 group differed from YS group at the ($p= 0.05$) level in the Holstein groups as well as in the Jersey groups. The statistical difference in ECM may be due to the different composition of the yeast used in the diet plus the stress caused by environment. The CC5 group and YS groups were statistically higher in average milk yield ($p=0.05$) than the CG group.

A positive response on milk yield appears to be found in those groups feed yeast.

[b] Cel-Con., Western Yeast Co., Inc. Chillicothe, IL. 2002
[c] YeaSacc 1026., Alltech Co, Lexington, Kentucky. 2003
[d] Control Group.

Based on these completed trials, the usage of yeast has a moderate impact on milk production as well as milk composition. These heat and transition trials suggest positive economical returns based on ECM from the usage of yeast.

# CHAPTER I

# INTRODUCTION

Animal nutrition is the cornerstone of all livestock production systems. Nutrition influences behavior, animal reproductive performance, and health. All animal gastrointestinal tracks have a complex system, sustained by living micro-flora. A good balance of this micro-flora in the gastrointestinal track can enhance digestion and maximum utilization of nutrients (Naidu, 1999).

The use of yeast culture as a pro-biotic supplement in animal diets, especially in dairy and beef cattle intensive production systems, is becoming more of a routine among livestock producers as a way to maintain a healthy rumen micro-flora. Better and healthier micro-flora translates in to better general animal heath and performance. This theory is supported by a series of scientific investigations that demonstrate the benefits of yeast in milk production, dry matter intake, and better digestibility and nutrients absorption (Naidu, 1999).

Yeast has been used for many centuries; to make bread, wine, and beer. It is believed that the origin of yeast goes back to Egyptian times, but there is documentation that it was first used by Asians in south and central China (Kreger, van Rij, 1984 ). It was not, until the 1860's that the properties of yeast began to be understood from the works of Louis Pasteur, on the phenomenon of fermentation. In 1857 Pasteur proved that fermentation was a physiological process, for he showed that the yeast which produced fermentation was no dead mass, as assumed at the time, but consisted of living organisms capable of growth and multiplication. The fermentation theory explains that live yeast, in the absence of oxygen, is responsible for the break down of carbohydrates (starches and sugars) to form alcohol and carbon dioxide gas. This process is known as anaerobic respiration or fermentation, and it has been used for centuries in the production of certain foods and beverages. This discovery allowed at the same time the controlled manufacture of yeast from a single special cell or yeast culture. (Kreger, van Rij, 1984)

Yeast is a microscopic single cell organism, a fungus of the plant kingdom. With nearly 50,000 species of fungi, there are only 60 different genera of yeast representing about 500 different species; a few of those are used commercially in the animal feed industry as active dry yeast or yeast culture. The cell multiplies by meiosis or strangulation in an average of 3 hours, with the capability of surviving in stream environment preserving its qualities (Kreger, van Rij, 1984).

In the market different types of yeast are available, but the most common are yeast culture and dry yeast. Yeast culture is a product which does not consist exclusively of yeast cells or yeast biomass, but, rather, is a yeast-fermented product designed to provide fermentation metabolites resulting from a specific fermentation process. Yeast cultures contain residual yeast viability, but, they are not considered a significant source of viable yeast cells or yeast biomass (Reed, 1991). Dry yeast is a live cell of yeast, in which most of the water has been extracted. This drying up technique is achieved by drying the cell at low temperatures. The obtained product contains around 10% of water, allowing yeast fermentative power, but maintaining its natural properties. (Newbold, 1995).

Yeast Culture or active dry yeast supplements help in the process of converting proteins, starches, and fibers into an easy form for absorption, resulting in better energy convention from feed. Yeast is also a source of vitamins, essential enzymes, and amino acids (Newbold, 1996). The original notion of using yeast in mature animals was to reduce the negative effects of stress caused by low quality diets. The concept was that beneficial yeast would replace pathogens in the intestinal track and increase microorganisms in the intestinal flora, but no thought had been given to possible help with stress caused by environment (Stokes, 1998).

Yeast increases the nutritional value of poor quality diets and the utilization of feed during any stress condition, by breaking down non available starches and nutrients into easiest forms for absorption (Mortimer, 1992). Some authors agree that dietary yeast appears to be most beneficial during the negative energy balance phase, when dairy cows are under stress to meet nutrient requirements (Newbold, 1996). Although yeast products (yeast cultures, active dry yeast) have official feed ingredient status, they vary extremely in colony-forming units and viable yeast. (Stokes, R.S., 1998)

Most dairy production facilities have a high animal density per area unit and, therefore, increase animal stress. Dairy rations may contain quickly fermentable starches resulting in rumen sub-clinical and clinical acidosis. For this use yeast cultures can be the most beneficial for dairy producers and for the animals (Mortimer, 1992).

Yeast as a TMR supplement, may have a modest effect in dairy cows performance by increasing the rumen fermentation and health. It may also promote better digestion and usage of nutrients.

The objective of these three studies was to evaluate the milk performance of pre- and post-partum and/or weather stressed cows, supplemented with yeast culture.

## Chapter II

## LITERATURE REVIEW

Yeast cultures are used extensively in diets for lactating dairy cows. Yeast supplements are usually marketed as a yeast culture and may contain both viable yeast cells and a dried preparation of the medium in which the cells were grown. Results of numerous studies with yeast supplementation to diets of lactating cows have been variable and inconsistent (Kilmer. 1993). Different studies have described the effects of yeast on the rumen health (Henics, 1992), rumen fermentation, rumen micro-flora (Nisbet, 1991), digestibility (Kim, 1992), and DMI (Wohlt, 1991). The effect on milk production has been variable (Kilmer. 1993). Improvements in milk production (Wohlt, 1991), milk fat percentage, and milk protein percentage (Harri, 1992) have been reported in some studies. However, other studies (Henics, 1992) showed no statistically significant response to yeast supplements.

Pure yeast cultures are grown in a medium of sugars, nitrogen sources, minerals, and water. The final product may take the form of dried yeast cells, or the yeast may be pressed into cakes with some starchy material. When a batch of yeast for baking, medicinal, or food purposes is completed, the medium in which the yeast was grown is discarded, but in animal feeding the medium can be beneficial in keeping the cell live (Stone, 1997).

The main effect of yeast culture is to stabilize the rumen environment. Observations of the concentration of cellulolytic and anaerobic bacteria are higher in invitro and in vivo systems when yeast is used. Rumen pH has been elevated in some studies with yeast cultures, but pH changes are not consistent. A reduction in rumen lactic acid concentrations has been reported (Williams, 1989). Yeast cultures are being studied to determine mode of action, optimum level, and correct stage of lactation to feed. Early lactation (2 weeks pre-partum to 4 weeks post-partum) appears to be an optimum time to feed yeast culture to stabilize the rumen environment as cows are shifted from dry cow to high-energy diets (Hutjens, 2005).

Physiology of the Yeast Cell

The yeast cell is a microscopic fungi, single cell organisms which are generally about 5-10 microns in size. They are in the family of e.g., *Saccharomyces cerevisiae* or *Candida utilis*. The species differ depending on where they are found, their cellular morphology, how they metabolize different substrates, and how they reproduce. Yeast is an anaerobic fungus, which means that they can survive and grow with or without oxygen (Newbold, 1995). Yeasts multiply as single cells that divide by maturing (eg. Saccharomyces) or direct division fission,(eg. Schizosaccharomyces), or they may grow as simple irregular filaments (mycelium). In sexual reproduction, most yeast cells contain up to eight haploid ascospores. These ascospores may fuse with adjoining nuclei and multiply through vegetative division or, as with certain yeasts, fuse with other ascospores. (Mortimer,1992).

One of the most important characteristics of yeast is the ability to ferment sugars for the production of ethanol. Yeast propagation is an aerobic process where the yeast converts oxygen and sugar, through oxidative metabolism, into carbon dioxide and usable free energy for efficient yeast cell growth (Stone, 1997). Yeast is common on plant leaves and flowers, soil and salt water. Yeasts are also found on the skin surfaces and in the intestinal tracts of warm-blooded animals, where they may live symbiotically or as parasites (Kreger van Rij, 1984).

Active dry yeast is the principal yeast offered to the animal feed industry, containing about 95% dry matter. There are other types of yeast like the wet yeast cake which contains 30% dry matter, and the yeast cream with 20% dry matter, used in the most cases for bread. Active dry yeast consists of yeast cells measured in units per gram (cfu) (Stone, 1997), with a medium that contains enzymes and metabolic intermediates. In the United States, tunnel dried and fluid-bed dried yeasts are most common, while rotolouver dried yeast is most prevalent in Europe and Latin America. The fluid-bed drying process is becoming more popular, because it causes less damage to the yeast cells, resulting in better leavening properties in the yeast"(Stone, 1997).

Yeast Cultures Potentials

Yeast culture products have been shown to modify rumen fermentation (Wiedmeier, 1987), by increasing the number of micro-bacteria and healthy micro-flora in the rumen (Harrrison et al., 1988), and increasing milk production in early lactation cows (McCoy, 1997; Sanchez, 1997). It is likely that yeast as a supplement for regular diets may prevent the reduction in dry matter intake (DMI) and the fluctuation in milk production during stress periods of time. Weather, calving, energy imbalances stress, and the reduction of DMI can be prevented by stimulating healthy microbial growth in the rumen by adding pro-biotics to the animal diet (Robinson, 1999).

However, if the pre-partum reduction in DMI is caused by the reduction of the rumen capacity because of the normal growth of the fetus, or by changes in the normal metabolism follow by a low ability to assimilate nutrients, then the addition of yeast or any other pro-biotic would have a modest or no effect in milk production and DMI (McCoy, 1997).

Robinson described a modest post-partum improvement in milk production of primiparus (n=18) and multi-parus (n=26) cows supplemented with yeast for 23 days pre-partum and 56 days postpartum, where two groups the "Control" TMR contained the appropriate concentrate both pre-partum and post partum, and "Yeast" group, TMR plus 57 grams a day of Yeast (XP yeast culture preparation, Diamond V Mills INC.), and concentrate pre-partum and postpartum. The overall performance of both groups of cows was not influenced by Yeast supplementation during the transition period. All variables were analyzed as separate experiments for both periods (pre and postpartum) using block treatments; cow with in treatments, time, and the interaction of time and treatment as factors were also analyzed with a low statistical correlation (Robinson, 1999).

Schingoethe (2004) reported the effects of yeast culture during heat stress on thirty-eight Holstein cows (26 multiparous and 12 primiparous). The cows averaged 105 days post-partum at the start of the experiment. The cows were feed 60 gm of yeast culture per cow per day (Diamond V XP) from early June until early September. After two weeks of treatment, cows were fed a control diet without or with 60 gm of yeast culture / cow daily for twelve weeks. Milk, energy-corrected milk, and DM were similar for cows fed control and yeast culture diets. Percentages of milk fat and true protein were similar for both diets. Feed efficiency defined as kilogram of ECM/kilogram of DM intake was improved by 7% for cows fed the yeast culture. Body weights and body condition scores were similar for both groups. The results suggest that the yeast culture can improve feed efficiency of heat stressed dairy cows in mid-lactation (Schingoethe, 2004).

Robinson (1999) reported better CP content in milk of multiparous (n = 26) and primiparous (n = 18) Holstein cows in a transition trial, fed pre-partum and post-partum TMR supplemented with a yeast culture for approximately 23 days pre-partum and 56 days post-partum. Although pre-partum performance of cows in control group and DMI and measures of body card scores (BCS) were not influenced by yeast culture. The degree of the pre-partum DMI depression was not influenced by yeast culture supplementation in either primiparous or multiparous cows of the research group (Robinson, P. H.. 1999). At the same time, Robinson sustains an intake behavior study with six multiparous cows; he suggested that cows supplemented with yeast culture demonstrate a repeated diurnal feed intake pattern until approximately 7 days pre-partum, versus 10 day pre-partum for non supplemented cows. Cows of both groups that were supplemented with yeast culture had numerically higher DMI and production of milk and milk components, although only DMI for multiparous cows and milk production for primiparous cows approached statistical significance. Intake behavior results suggested that cows supplemented with yeast culture achieved repeated diurnal feed intake patterns by approximately 14 day postpartum, versus 20 day post-partum for not supplemented cows. The overall results show a modest post-partum improvement in performance of primiparous and multiparous cows supplemented with this yeast culture for 23 days pre-partum and 56 days post-partum. However, primiparous cows seemed to achieve this modest overall improvement primarily through enhanced post-partum DMI, where as in multiparous cows it was due almost equally to enhanced post-partum DMI and higher energy density of the diet since the cows were in high energy production TMR (Robinson, 1999).

Yeast Studies on Lactation Performance

Feed additives and management tools such as yeast cultures, play an essential role in enhancing production and yield of milk and milk components (Middelveld, 2005). Producers have to evaluate the cost - benefit of each feed additive in their management systems. Feeding strategies and additives optimize rumen function and utilization of feed which results in higher milk production, milk composition, and yield (Looper, 2005).

As described by Erasmus (2005), the supplementation of a yeast culture and the influence of it on pre-partum and postpartum ruminal fermentation and milk performance is modest. This is confirmed after an adaptation trial, where sixty multi-parous Holstein-Friesian cows were utilized in a randomized complete block design experiment to evaluate effects of feeding a yeast culture (*Saccharomyces cerevisiae*), monensin, or both, on their rumen fermentation patterns and performance. Treatments were divided on first control diet "TMR and concentrate", second control diet plus 2550 ppm (DM basis) of a *yeast* culture, third control plus 10 ppm (DM basis) of monensin and forth control plus 2550 ppm (DM basis) of yeast culture plus 10 ppm (DM basis) of monensin. Cows were fed their TMR twice daily from 3 weeks pre-partum until 8 weeks post-partum. Cows were milked twice daily. Compared to the control group, mean milk yield, milk composition and body weight change of treatment groups did not differ from the others, although milk CP yield progressively increased with yeast culture, and decreased with monensin as the level of milk CP production of the cows increased. Results suggest a modest complementary effect between yeast culture and monensin, as yeast culture tended to alleviate the depression in mean DMI caused by monensin (Erasmus, 2005).

Most lactation studies only used one type of yeast product or a specific level of supplementation of yeast culture. But as Wohlt reports in a double research, were thirty-six multi-parous Holstein cows were fed a mixture of corn silage, and concentrate the benefits of yeast couture were definitive. Eighteen of these cows were supplemented daily with 10 g of Bio-mate Yeast Plus (Chr. Hansen's, Inc., Milwaukee, WI). The other eighteen cows served as controls for 30 days pre-partum through week 4 of lactation. At week 5, both control and research cows were divided into three groups and fed 0, 10 or 20 g/d of yeast. Here yeast supplementation during early lactation shows a significant improvement of DM intake, milk yield, and the digestibility of crude protein and acid detergent fiber, demonstrating the theory of better use of nutrients when Yeast is added to the normal feed ration.( Wohlt, 1998)

Distinguished from others, Arambel, reported that the addition of Saccharomyces cerevisae yeast culture in the diet of early to mid lactation Holstein cows had no effect on milk yield, or apparent digestion of nutrients between groups. Each group (Control and Yeast) composed of 10 Holstein dairy cows in early lactation were located equally to one of two treatments on the basis of age, days in milk, and mean daily two-week pretrial milk yield. All animals were fed a TMR; the ration for the treatment group was top-dressed with 90 g/day of yeast culture, *Saccharomyces cerevisiae* with no apparent results or statistical difference (Arambel, 1990).

Yeast Studies on Ruminant Health and Nutrition

Only a few studies examining yeast in the rumen have been done in the last decade. However, yeast is a critical component of the rumen as evidenced by the fact that yeast feed additives have been used as an alternative to antimicrobial feed additives for more than 20 years. Some of the benefits associated with the presence of yeast in the rumen include: increased dry matter digestion (Carro et al. 1992), increased initial rates of fiber digestion (Williams et al. 1991), and increased milk production and composition in dairy cattle (Kung et al. 1997).

Effects of yeast culture on ruminal fermentation in Holstein cows has been recorded with mild benefits (Williams et al. 1991). As reported by Mwenya (2005), four non-lactating, ruminally cannulated Holstein cows were used in a 4 x 4 Latin square design, balanced for residual effects, to evaluate the effects of supplementing dairy cow diets with yeast culture (*Trichosporon sericeum*), galacto-oligosaccharides, or the mixture of yeast culture and galacto-oligosaccharides on ruminal fermentation, microbial N supply, in situ degradation, and energy and nitrogen metabolism. Treatments were arranged in a 2 x 2 factorial as follows: 1) basal diet, 2) basal diet plus 10 grams a day yeast culture, 3) basal diet plus 2% galacto-oligosaccharides, 4) basal diet plus a mixture of 10 grams a day yeast culture and 2% galacto-oligosaccharides. Nitrogen losses in urine were lower, and retained N was higher, for cows supplemented with a mixture of yeast culture and galacto-oligosaccharides. Ruminal pH was lower in cows supplemented with galacto-oligosaccharides alone compared with other treatments. Total VFA concentration was higher in cows fed control and galacto-oligosaccharides -supplemented diets than in those fed yeast culture-containing diets. Microbial N supply was higher in cows fed control diets. There were no major positive effects of supplements observed in this study. However, supplementation of a mixture of yeast culture and galacto-oligosaccharides had a tendency for synergistic effects on N metabolism and in situ degradation of a soluble fraction of oat straw DM and CP of concentrates compared with supplementation of yeast culture or galacto-oligosaccharides alone (Mwenya, 2005).

For years yeast cultures have been added to diets for dry and lactating dairy cows to improve ruminal fermentation, potentially increasing DMI and milk yield. As further explanation for this interaction, Dann (2000) observed in Jersey cows fed TMR pre-partum and post-partum that were either supplemented or not supplemented with yeast culture, a significant treatment interaction. In his analysis, he indicated that cows supplemented with yeast culture lost body weight less rapidly post-partum than those that were not supplemented. A significant interaction of treatment by day point out that every cow supplemented with yeast culture reached peak milk production more quickly than those not supplemented. However, total milk produced during the first 140 days of lactation did not differ. Concentrations of fat, protein, lactose, total solids, and urea N in milk, as well as somatic cell count, were not significantly affected by yeast culture. Supplementation of yeast culture increased DMI during the transition period and increased DMI postpartum (Dann, 2000)

More refined experiments investigate the effects of different concentrations (0, 0.33, 0.66, 0.99, and 1.32 g/L) of a twin-strain of *Saccharomyces cerevisiae* live cells on in vitro mixed ruminal microorganism fermentation of corn starch, soluble potato starch, and sudan grass hay (60.5%, DM basis) plus concentrate mixture (39.5%, DM basis).

Ruminal fluid was collected from two dairy cows, mixed with phosphate buffer

(1:2), and incubated (30 mL) anaerobically at 38°C or 100.4°F for 6 and 24 hours with or without yeast supplement, using 200 mg (DM basis) of each substrate. Medium pH, ammonia-N, and numbers of protozoa were unaffected ($P = 0.38$) by yeast cells in all substrates. Molar proportion of acetate was unchanged ($P = 0.56$) with cornstarch and soluble potato starch, but increased quadratically ($P = 0.02$) with hay plus concentrate by treatment. Addition of yeast cells caused a linear increase of total VFA ($P = 0.008$) in all substrates. Excluding the soluble potato starch, supplementation of *S. cerevisiae* resulted in a quadratic increase of propionate ($P = 0.01$), with a quadratic decrease ($P = 0.04$) of acetate: propionate. When cornstarch and soluble potato starch were used as a substrate, minor VFA were decreased ($P = 0.05$) by treatment. Accumulation of lactate was linearly decreased by treatment ($P = 0.007$) in all substrates. During incubation with hay plus concentrate, IVDMD was linearly increased ($P = 0.006$), whereas production of methane (linear; $P = 0.02$) and accumulation of hydrogen was decreased (quadratic; $P = 0.005$) by treatment after twenty four hours. These results showed that a twin strain of s*p. cerevisiae* live cells stimulated in vitro mixed ruminal microorganism fermentation with decreased lactate, and a small decrease of methane and hydrogen with hay plus concentrate (Lila, Z.A. 2004).

# CHAPTER III

# MATERIALS AND METHODS

## Introduction

The yeast culture trials were conducted at the Western Kentuky University Agricultural Research and Educational Complex in Bowling Green, Kentucky.

The objective of this studies was to determine the effects effect on milk yield of Western Yeast 2x-2-2-5 plus fed during heat stress conditions to pre- and post-partum cows for the first trial; to evaluate the effect of 2X-2-2-5 PLUS yeast fed during heat stress conditions to lactating dairy cows; and to determine the effects of two different types of yeast culture fed during weather stress conditions to post-partum cows.

The experimental design was a randomized complete block analysis with more than one observation per treatment per block. All mean comparisons were done using the t-Test at the $p \leq 0.05$ level of significance.

## Trial 1.

Sixteen cows per group paired by breed (Jersey and Holstein), lactation number and days in milk were assigned to CG "no yeast" or WY (20oz a day of 2X-2-2-5 Plus Western Yeast) (Appendix 1). Both groups were fed a TMR consisting of corn silage, alfalfa hay and haylage, grain mix including whole cottonseed, and also had controlled access to alfalfa pasture. The trial began on August 6, 2003 and lasted for 40 days. Cows were weighed 3 times during the trial. Milk weights were captured at each milking using electronic weigh meters, which download into a computer. Butterfat and protein % were determined from DHI samples (Table 1). Data were analyzed by randomize complete block analysis of variance ANOVA using S.P.S.S.-13© software, and seven day average milk weights. Both groups were subjected to the same heat stress conditions (Figure 1). During the trial one cow from each group had to be removed for health reasons. The matching paired cow from the other group was removed so the final results were based on 14 cows per group.

Trial 2.

Six cows per group paired by breed (Jersey and Holstein), lactation number and date of calving were fed pre-partum and lactating TMRs consisting of corn silage, alfalfa hay and haylage, grain mix, whole cottonseed and controlled access to alfalfa pasture. Cows were assigned to CG (no yeast) or WY (2oz a day of 2x – 2-2-5 Western Yeast) group. Milk yield, fat and protein percentage were recorded for the first 60 days of lactation on each animal. Data were analyzed by randomize complete block analysis of variance ANOVA and a separation of means by the T-test was performed using S.P.S.S.-13© software, and seven day average milk weights (Table 3, 4). The trial ran between August 28, 2003, and January 3, 2004, with the first cow fresh on August 28 and the last cow fresh on November 3, 2003.

Milk weights were recorded at each milking, using electronic weight meters, which download into a computer. Individual animal milk fat and protein percent were determined by laboratory analysis three times during the trial (Table 2).

Trial 3.

Nine to eleven cows per group were assigned by breed and lactation number to control, Cel-Con 5 (CC5) (Appendix 2) or Yea-Sacc 1026 (YS) (Appendix 3), random complete block treatment groups. All cows received a ration of corn silage, alfalfa hay, whole cottonseed and grain mix plus the manufacturer recommended amount of yeast daily for the two treatment groups. Milk yield, fat and protein percentage were measured for the first 56 days of lactation. Cattle were started on yeast twenty one days before their due date and were in weather stress through most of this study.

Milk weights were captured and recorded at each milking using electronic weight meters, which download into a computer (Table 6, 7). Using S.P.S.S.-13© software, data was analyzed using mix model of ANOVA and a separation of means by a t-Test (Table 8). Seven day average milk weights were used for the analysis in all the trials (Figure 5, 6).

# CHAPTER IV

## RESULTS AND DISCUSSION

Dairy cow nutrition models are imperative for the continued success of the dairy farm industry (Grimes, 2004). Yeast culture products have been shown to stimulate milk production, composition, and overall animal performance (Wiedmeier et al., 1987; Harrison et al., 1988; Dawson et al., 1990; Erasmus et al., 1992). Such changes in performance are often associated with increased digestibility of the diet due to the addition of yeast culture to the diet, which can lead to higher DMI or better milk yields, or both. Results of a previous study (Robinson, 1997) were consistent with such a hypothesis, although those results did not demonstrate a great difference on yeast supplemented to the diet versus those that are not.

Trial 1.

Using S.P.S.S.-13© software, data was analyzed by the *analysis of variance* and a separation of means by a t-Test (Stell, 1980). A significant difference was found at the ($p$=0.05) level between milk yield and ECM in the Holstein WY group (Figure 2). The limited Jersey sample size did not provide adequate statistical data for analysis.

Trial 2.

Using S.P.S.S.-13© software, data was analyzed by the *analysis of variance* and a separation of means by a t-Test (Stell, 1980) (Table 3 Holstein, Table 4 Jersey). Milk yield and energy corrected milk were not statistically different in Holsteins and controls ($p$=0.22) and ($p$=0.17), but were statistically different in Jerseys and controls ($p$=<0.05) and ($p$=<0.05), group.

Milk yield and ECM were statistically higher for the Jersey's versus the controls, but not the Holsteins versus the controls even though the ECM for yeast fed Holsteins was 72.37 lbs per day and the controls 66.79 lbs day (Figure 3,4).

Trial 3.

Using S.P.S.S.-13© software, data were analyzed by the *analysis of variance* and a separation of means by a t-Test (Stell, 1980) (Table 7).

- <u>Holstein</u>
- CC5 vs YS Milk yield: $p$=0.05, ECM $p$=0.034
- CC5 vs control Milk yield: $p$=0.131, ECM $p$=0.0056
- YS vs control Milk yield: $p$=0.40, ECM $p$=0.38
- <u>Jersey</u>
- CC5 vs YS Milk yield: $p$=0.0113, ECM $p$=0.035
- CC5 vs control Milk yield: $p$=0.0095, ECM $p$=0.0056
- YS vs control Milk yield: $p$=0.4, ECM $p$=0.38

- * p=<0.05 is significant

Energy corrected milk was statistically higher ($p$=<0.0056) in the CC5 groups versus the control (no yeast) group. The Holsteins and Jerseys differed in milk yield and energy corrected milk response to yeast feeding.

- Cel Con 5 2X-2-2-5+ (Western Yeast Company)
- YeaSacc 1026 (AllTech)

Annotations

Yeast provides factors that stimulate improved milk and butterfat production, ruminant health, and improved fiber digestion even in times of stress; the use of yeast or any other probiotic is recommended at any time when improved productions is desired, but not with the expectation of extreme variability since mild differences were found to result during the trial. Also it is suggested that most benefits are seen in high producing cows or cows in early lactation, and should be used to help with a better utilization of rations for maximum production, during periods of heat stress when milk and butterfat production normally decline, for cows in late lactation, while trying to maintain production and feed efficiency; or during periods when only poor quality roughages are available. Feeding rates ranged from 10 to 120 grams per day per heat depending on yeast culture concentration. The cost is approximately 4 to 6 cents per cow per day. The estimated benefit-to-cost ratio is 4-to-1.

While there would be some benefit in conducting other trials similar to this one, it may perhaps be of interest to carry out trials with different amounts of yeast content in different rations and more animals in each plot. A back cross trial with animals coming in and out of treatment, based in three stages of lactation or production, would generate much more accurate statistical data that might show greater differences and more reliable information.

**Table 1.** W.K.U. Yeast Trial 1. Animal Performance at 40 days analysis.

| **40 DAYS ANALYSIS** | | |
|---|---|---|
| **Animal Performance Holsteins Group** | **Control** | **Western Yeast 2x225 plus** |
| Average Milk Yield (lb) | 61.40 | 62.86 |
| | | |
| Average butterfat% | 3.52 | 3.44 |
| Average butterfat (lb) | 2.16 | 2.16 |
| | | |
| Average protein % | 3.05 | 3.13 |
| Average protein lb | 1.87 | 1.97 |
| | | |
| 3.5%FCM | 61.57 | 62.22 (+0.65) |
| Fat & Protein Corrected milk (lb) | 60.91 | 62.06 (+1.15) |

**Table 2.** W.K.U. Yeast Trial 2. Animal performance at 60 days analysis.

| 60 Days Analysis | | |
|---|---|---|
| **Animal Performance Holsteins** | **Control** | **Western Yeast** |
| Average Milk Yield (lb) | 66.18 | 71.13 |
| | | |
| Average butterfat% | 3.66 | 3.80 |
| Average butterfat (lb) | 2.42 | 2.70 |
| | | |
| Average protein % | 3.04 | 2.90 |
| Average protein lb | 2.01 | 2.06 |
| | | |
| 3.5%FCM | 67.87 | 74.56 (+6.69) |
| Fat & Protein Corrected milk (lb) | 66.79 | 72.37 (+5.58) |

**Table 3.** W.K.U. Yeast Trial 2. t-Test

| t- Test | | |
|---|---|---|
| **Animal Performance Holsteins** | **control** | **Western yeast** |
| Average Milk Yield (lb) | 66.18 | 71.13 |
| Fat & Protein Corrected milk (lb) | 66.79 | 72.37 |
| SD | 16.97 | 17.23 |
| sample size | 36 | 36 |
| p=0.05 | milk yield | ECM |
| control vs western yeast | p=0.2235 | p=0.1706 |

**Table 4.** W.K.U. Yeast Trial 2. t-Test

| t- Test | | |
|---|---|---|
| **Animal Performance Jersey** | **control** | **western yeast** |
| Average Milk Yield (lb) | 43.90 | 58.30 |
| Fat & Protein Corrected milk (lb) | 49.40 | 66.28 |
| SD | 10.64 | 11.63 |
| sample size | 18 | 18 |
| p=0.05 | milk yield | ECM |
| control vs western yeast | p=4.6E-04 | p=6.66E-05 |

**Table 5.** W.K.U. Yeast Trial 3. Milk - energy analysis

| **Animal Performance Holstein** | **Control** | **Cel Con 5a (WY)** | **YeaSacc 1026b** |
|---|---|---|---|
| Average Milk Yield (lb) | 67.02 | 75.52 | 63.97 |
| | | | |
| Average butterfat% | 3.62 | 4.10 | 4.19 |
| Average butterfat (lb) | 2.43 | 3.10 | 2.68 |
| | | | |
| Average protein % | 2.80 | 3.32 | 3.14 |
| Average protein lb | 1.88 | 2.51 | 2.01 |
| | | | |
| 3.5%FCM | 68.29 | 82.84 | 71.10 |
| Fat & Protein Corrected milk (lb) | 66.16 | 81.99 | 69.37 |

**Table 6.** W.K.U. Yeast Trial 3. Milk – energy analysis

| **Animal Performance Jersey** | **Control** | **Cel Con 5a (WY)** | **YeaSacc 1026b** |
|---|---|---|---|
| Average Milk Yield (lb) | 39.75 | 47.95 | 56.12 |
| | | | |
| Average butterfat% | 5.11 | 4.69 | 4.54 |
| Average butterfat (lb) | 2.03 | 2.25 | 2.55 |
| | | | |
| Average protein % | 3.55 | 3.49 | 3.69 |
| Average protein lb | 1.41 | 1.67 | 2.07 |
| | | | |
| 3.5%FCM | 50.10 | 57.18 | 65.56 |
| Fat & Protein Corrected milk (lb) | 48.95 | 56.26 | 65.56 |

**Table 7.** W.K.U. Yeast Trial 3. t-Test

| t- Test | | | |
|---|---|---|---|
| **Animal Performance Holsteins** | **Control** | **Cel Con 5a (WY)** | **YeaSacc 1026b** |
| Average Milk Yield (lb) | 67.02 | 75.52 | 63.97 |
| Fat & Protein Corrected milk (lb) | 66.16 | 81.99 | 69.37 |
| SD | 17.69 | 31.96 | 12.1 |
| sample size | 40 | 56 | 32 |
| p=0.05 | milk yield | ECM | |
| Western yeast vs yea sacc | p=0.05 | p=0.0349 | |
| control vs yea sacc | p=0.408 | p=0.38 | |
| control vs western yeast | p=0.131 | p=0.0056 | |

**Table 8.** W.K.U. Yeast Trial 3. t-Test

| t- Test | | | |
|---|---|---|---|
| **Animal Performance Jersey** | **Control** | **Cel Con 5a (WY)** | **YeaSacc 1026b** |
| Average Milk Yield (lb) | 39.75 | 47.95 | 56.12 |
| Fat & Protein Corrected milk (lb) | 48.95 | 56.26 | 65.56 |
| SD | 15.28 | 14.62 | 12.99 |
| sample size | 40 | 55 | 31 |
| p=0.05 | milk yield | ECM | |
| Western yeast vs yea sacc | p=0.0113 | p=0.0041 | |
| control vs yea sacc | p=9.769 | p=7.517 | |
| control vs western yeast | p=0.0095 | p=0.0203 | |

**Figure 1.** W.K.U. Yeast Heat Trial 1. Milk yield Vs Temperatures in Warren County

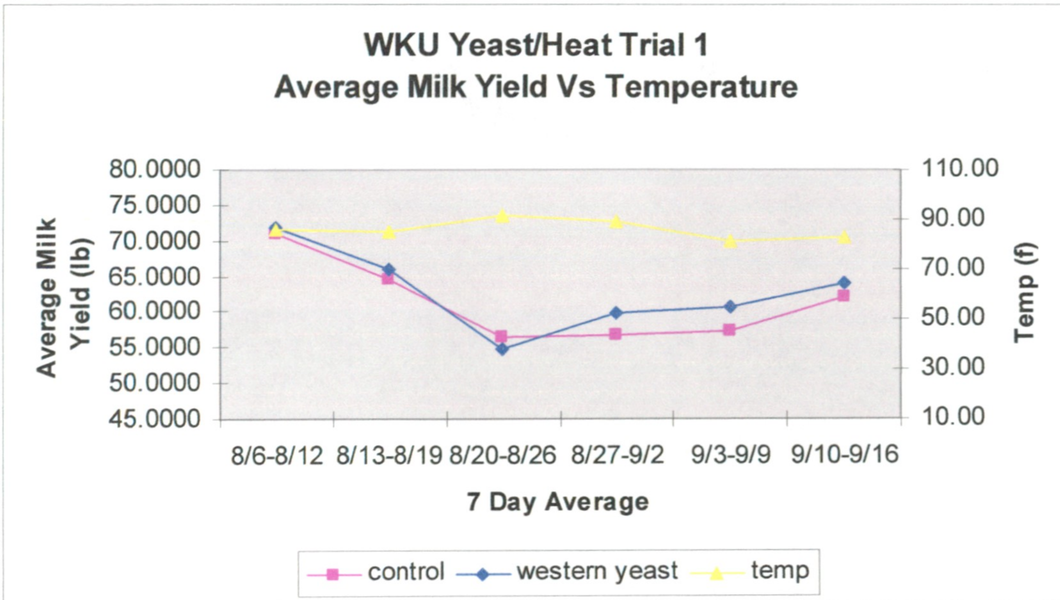


**Figure 2.** W.K.U. Yeast Heat Trial 1. Average Milk Yield.

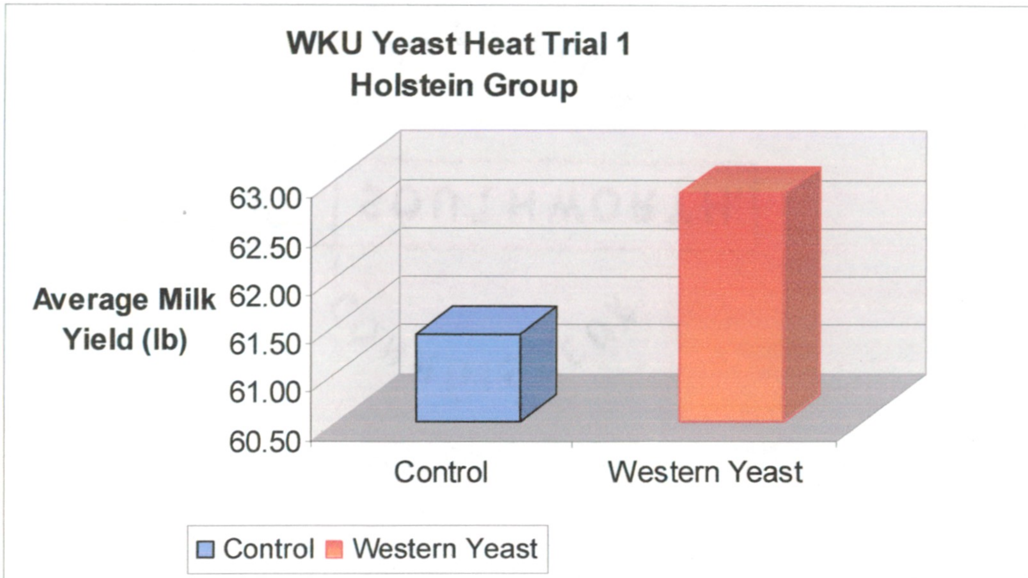


**Figure 3.** W.K.U. Yeast Trial 2. Average Milk Yield.

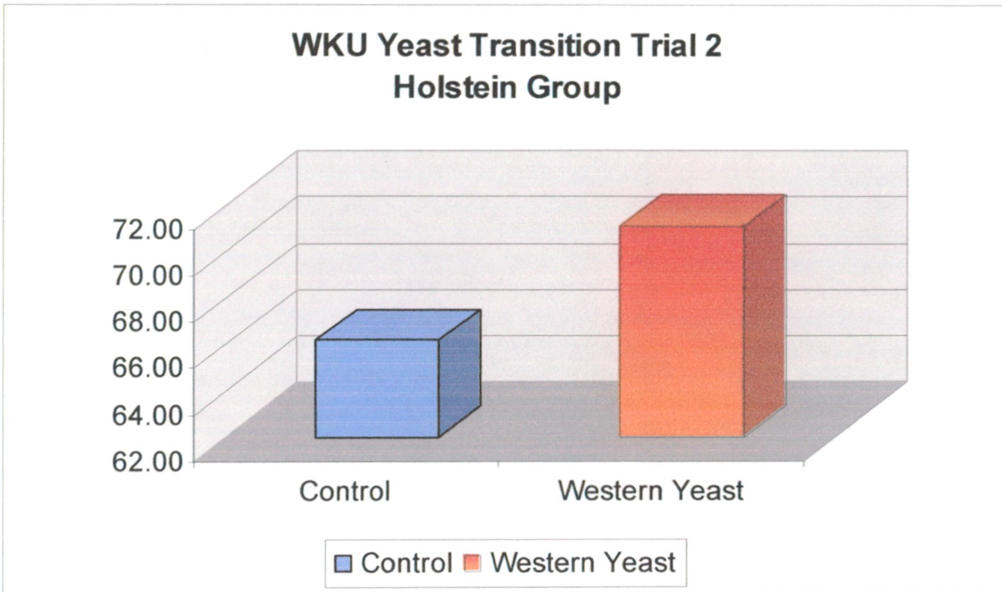


**Figure 4.** W.K.U. Yeast Heat Trial 2. Average Milk Yield.

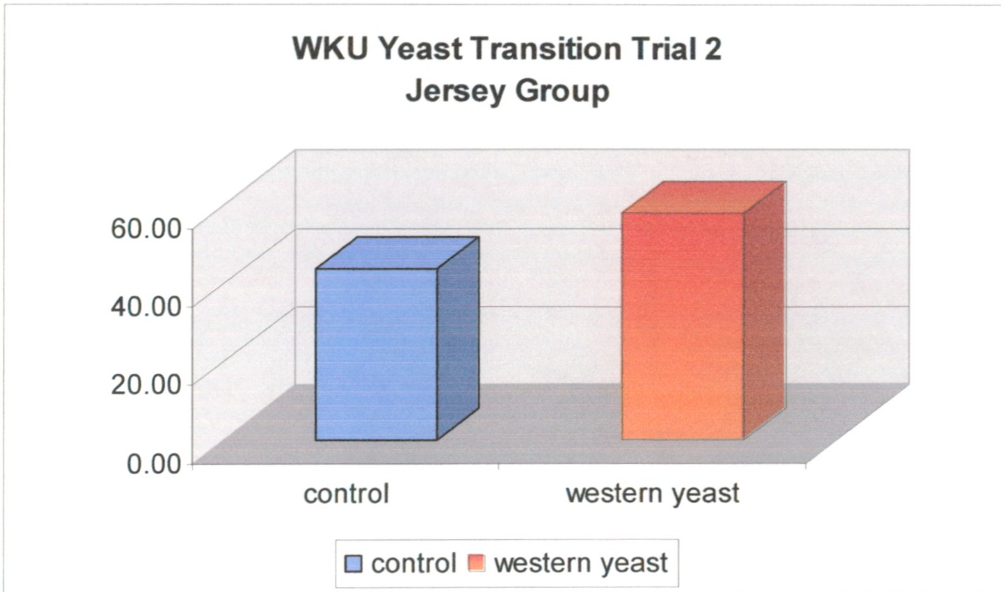


**Figure 5.** W.K.U. Yeast Trial 3. Average Milk Yield. Comparison of three groups.

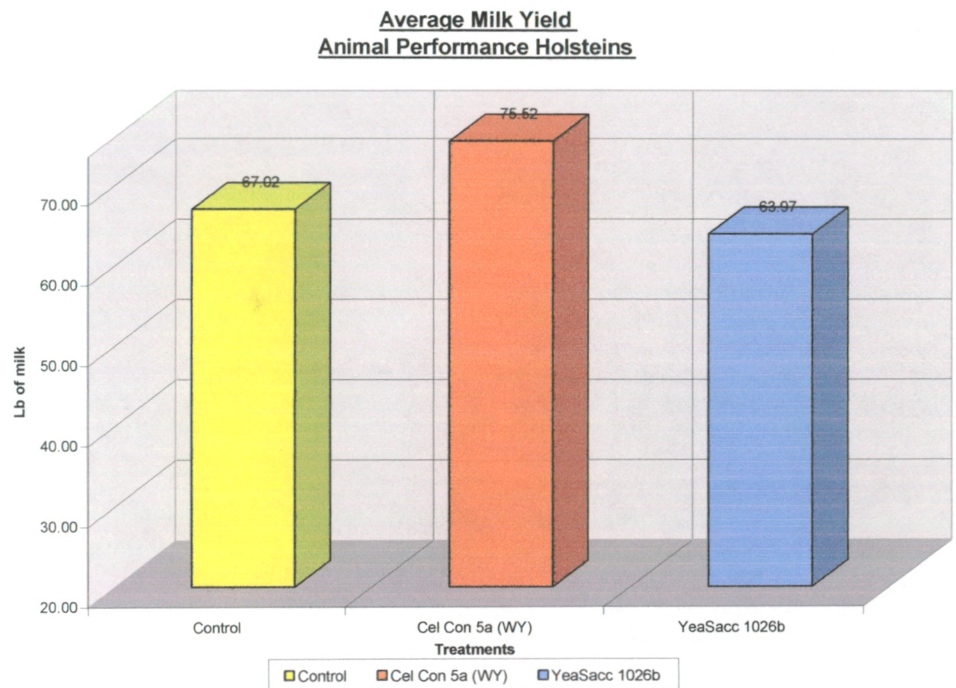
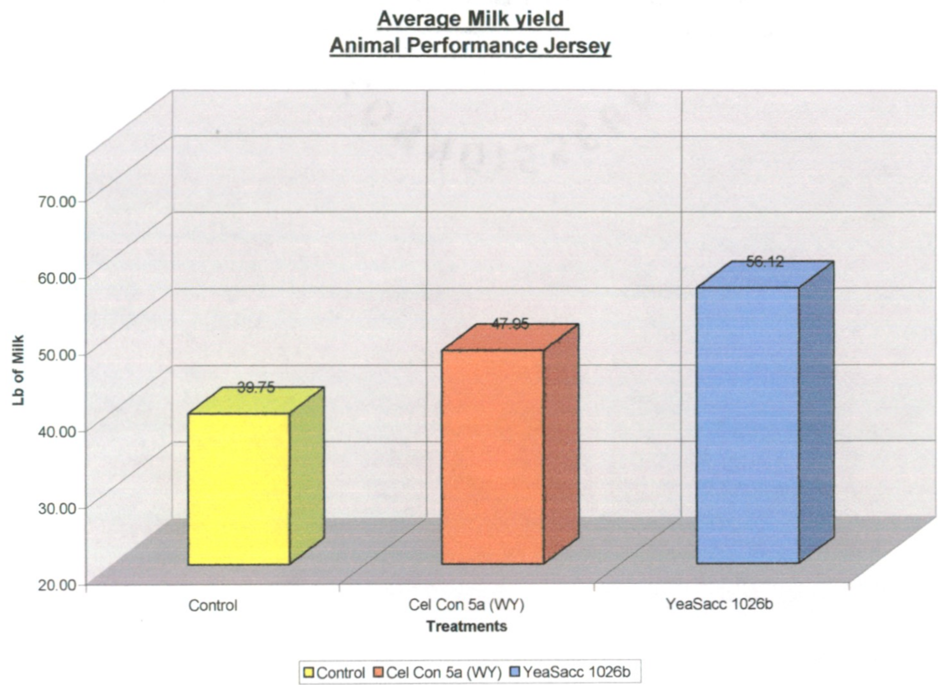


**Figure 6.** W.K.U. Yeast Trial 3. Average Milk Yield. Comparison of three groups.



# CHAPTER V

# SUMMARY

Lactation is normally a stressful period for the dairy cow, during which large quantities of energy are used to support milk yield. As a result of this stress caused from the lactation plus weather conditions and environment, DMI and overall performance decreases at this time.

The supplementation of diets with yeast improved animal performance through periods of severe stress. Yeast culture supplementation results in a modest overall improvement in performance of dairy cows, but the data do not completely support this.

However, a dairy diet supplemented with yeast culture produced modest increases in energy corrected milk due to the possible increases in dry matter intake in addition to enhanced energy density of the diet.

This study illustrated the value of supplemental yeast in TMR rations based on corn silage that were fed to high yielding dairy cows through different stages of lactation and environmental stress. Interest in feed additives will continue and will be influenced by new research results, advertising, and profit margins.

# APPENDIX

Appendix 1.

Western Yeast Manufacture Analysis

| | |
|---|---|
| YEAST CULTURE<br>2X-2-2-5 Plus<br>For Further Manufacture of Feed<br>GUARANTEED ANALYSIS | |
| Crude Protein, minimum | 12.00% |
| Crude Fat, minimum | 3.00% |
| Crude Fiber, maximum | 5.00% |
| **INGREDIENTS-YEAST CULTURE**<br>Active Saccharomyces cerevisiae Yeast grown and dormantized on ground yellow corn, corn gluten meal, condensed fermented corn extractives, cane molasses and malted barley. | |

*Provide by: Western Yeast Company, Chillicothe, U.S.A. 2002.

Appendix 2.

Western Yeast Manufacture Analysis

| CEL-CON-5<br>YEAST CULTURE<br>For Further Manufacture of Feed<br>GUARANTEED ANALYSIS* | |
|---|---|
| Crude Protein, minimum | 18.00% |
| Crude Fat, minimum | 3.00% |
| Crude Fiber, maximum | 5.00% |
| **INGREDIENTS-YEAST CULTURE**<br>Active *saccharomyces cerevisiae* yeast grown and dogmatized on ground yellow corn, corn gluten meal, condensed fermented corn extractives, cane molasses and malted barley. | |

*Provide by: Western Yeast Company, Chillicothe, U.S.A. 2002.

Appendix 3.

Alltech ManufactureYeast Analysis

| Yea Sacc 1026<br>YEAST CULTURE<br>For Further Manufacture of Feed<br>GUARANTEED ANALYSIS* | |
|---|---|
| Crude Protein, minimum | 18.00% |
| Crude Fat, minimum | 8.25% |
| Crude Fiber, maximum | 8.00% |
| **INGREDIENTS-YEAST CULTURE**<br>*Saccharomyces cerevisiae* strain 1026 | |

* by: Alltech, U.S.A. 2002.

CHAPTER VI

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