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Effects of the Selenium and Vitamin E in the Production, Physicochemical Composition and Somatic Cell Count in Milk of Ayrshire Cows

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Abstract: The objective that lasted 270 days was to evaluate the production, chemical composition, somatic cell count in milk and body condition score in Ayrshire cows. About 20, first lactation cows were randomly assigned to one of two treatments: T1 = control, T2 = selenium and vitamin E. Identical management and diets were fed in both treatments. Performance responses to Selenium (Se) and vitamin E supplementation increases ($p<0.05$) daily Milk Production (MP) T1 = 8.63 vs. T2 = 9.34, percentage of Crude Protein (CP), Solids Non Fat (SNF) and lactose. Percentage of Milk Fat (MF) and content of Total Solids (TS) was not affected by treatment ($p>0.05$). Decreased number ($p<0.05$) of Somatic Cells Count (SCC) was attributable to dietary Se and vitamin E supplementation (2.053 vs. 1.509). Body Condition Score (BCS) in both treatments was similar between treatments (2.5-3.0). Researchers conclude that the incorporation of Se and vitamin E in commercial diets of grazing first lactation cows increases MP and percentage of CP, SNF and lactose content and decreases SCC while BCS of animals were unaffected by treatment. This data confirm earlier findings that Se and vitamin E supplementation are related to mammary health gland. The performance and economic feasibility of the use of selenium plus Vit. E allowed us to obtain a profit margin of $0.21 (US cents) per animal per day in this study.

Key words: Dairy cattle, milk, production and quality, selenium-vitamin E, somatic cell, body condition

INTRODUCTION

When the mammary gland is infected by pathogenic microorganisms it reduces milk synthesis resulting in changes in its composition and quality (Tufarelli *et al*., 2011) and elevated SCC (Sarikaya and Bruckmaier, 2006). The nutrition of the dairy cow requires high precision in the nutrients to be considered in the ration. Seven trace elements are generally accepted as essential in livestock including Selenium (Se) (Schwarz, 1974). Selenium and vitamin E may affect the overall health of the dairy cow due to the close relationship and effect on health of the mammary gland and milk composition (Juniper *et al*., 2006; Rhone *et al*., 2008). Mastitis is the most common and costly disease of dairy cattle which can be detected by various techniques however, somatic cell count per milliliter of milk is the most reliable at present. Koc (2008) notes that stress reduction and health policy implementation reduce the levels of somatic cells. It is mentioned that there is a difference between breeds with respect to the incidence of mastitis; possibly genetic conditions of the various breeds of cattle have defense mechanisms against this disease (Koc and Kizilkaya, 2009). The objective is to evaluate the effect of Se and vitamin E supplementation on milk production and composition, somatic cell count and body condition score of first lactation Ayrshire cows under grazing systems in the North region of Mexico.

MATERIALS AND METHODS

Facilities: This research was carried out in the commercial dairy called Rancho HV located in the Bachomobampo Ejido, Municipality of Ahome, Sinaloa, Mexico. It is located in West longitude and latitude 12'00 1090 45'00 250 North to 27 km from the city of Los Mochis Sinaloa at a height of 10 m above sea level. This region presents a warm and semi dry weather with an average annual temperature of 24.0°C with maximum extreme of 50°C and minimum of 3.0°C; annual precipitation of 450-550 mm of summer rain.

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Cows, diets and management: The study lasted 270 days. About 20, first lactation Ayrshire cows with an average body weight of 400 kg were grouped into two groups of 10 cows each and randomly assigned to one of two dietary treatments: T1 = control and T2 = Se and vitamin E. Lactating animals were pastured using a rotational stocking method with alfalfa legume cultivar as forage (*Medicago sativa*) and supplemented with sorghum silage (silo honey), alfalfa hay, molasses, corn and a 16% CP commercial concentrate. The feed offered was adjusted on the basis of dry matter. In order to ensure confor, each cow was housed after morning grazing in a corral surface of 60 m^2; watering facilities (2 drinkers at 2 m^2) and a shadow area of 5 m^2 was provided. Selenium and vitamin E was offered as zinc L-selenomethionine which is a commercial supplement (Availa®Se ZINPRO™). The dose given to the treatment cows consisted of 0.3 mg kg^{-1} plus 300 U.I. vitamin E kg^{-1}. Cows were milked once a day and milk weights recorded. Twice a month individual samples of each quarter were taken from each animal in the morning milking then at the end of the experiment we had 720 samples of milk per cow. Approximately, 10-15 mL of milk from each quarter per animal were collected in bottles with screw caps and stored at 4°C. Every 2 weeks, BCS of cows were determined using a subjective scale with intervals of 0.1. A score of one indicated a very thin cow and five a very obese cow (Talafha *et al*., 2009).

Chemical analyses: The physical and chemical components of milk (fat, protein, lactose and solids non-fat) were determined by an automatic infrared spectroscopy called Milko-Scan® in the dairy laboratory of the Autonomous Metropolitan University. Milk samples for each quarter were assayed for somatic cells count after the preheating at 40°C in a water bath and its homogenization by using a fluorescence microscope (Fossomatic®) at the University Center for Biological and Agricultural Sciences of the University of Guadalajara. The rations samples were assayed for Dry Matter Apparent (MSA dried at 60°C for 48 h) Residual Dry Matter (MSR dried at 105°C for 24 h), Neutral Detergent Fiber (NDF) and Acid Detergent Fiber (ADF) (Goering and van Soest, 1970) at the Laboratory of Food Science and Animal Nutrition, School of Agronomy of the Autonomous University of Sinaloa.

Statistical analysis: The variable chemical composition of milk and production were tested with parametric model assumptions and to meet these design researchers analyzed in a mixed effects for repeated measurements, the animals constituting the random effect and the sampling periods fixed effect (Spilke *et al*., 2009). We made comparisons of means with the Tukey test. Somatic Cell Count (SCC) data were transformed logarithmically as follows: SCS = log2 (SCC/100000)+3 (Ali and Shook, 1980), analyzing the evidence with Friedman's non parametric statistical evidence. We used a significance level ($p<0.05$) in all cases. For the analysis of the variables of interest was used SAS Version 9.2 in 2003.

RESULTS AND DISCUSSION

Averaged MP was affected by treatment ($p<0.05$). Figure 1 shows that cows supplemented with Se and vitamin E had higher daily MP compared with control cows (9.34 vs. 8.64 kg) this value represents an increment of about 8.07%. An interaction between the values of the monthly chemical analysis of the percentage of milk fat (Fig. 2), CP (Fig. 3) and TS (Fig. 4) was observed. No interaction between month of sampling and treatment was found due to treatment in SNF (Fig. 5) and lactose milk (Fig. 6). Nevertheless, when data of for monthly 1-9 were averaged the group of cows receiving Se and Vit. E supplementation increased ($p<0.05$) percentage of milk CP, SNF and of lactose (Table 1). On the other hand, no difference ($p>0.05$) was found in the percentage of fat

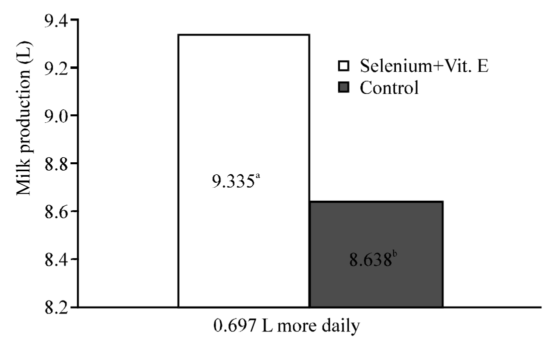

Fig. 1: Effects of Se and vitamin E supplementation on milk production of first lactation Ayrshire cows

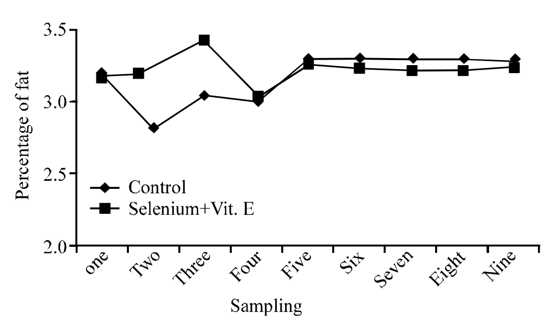

Fig. 2: Effects of Se and Vit. E supplementation on percentage of fat in Ayshire first lactation cows

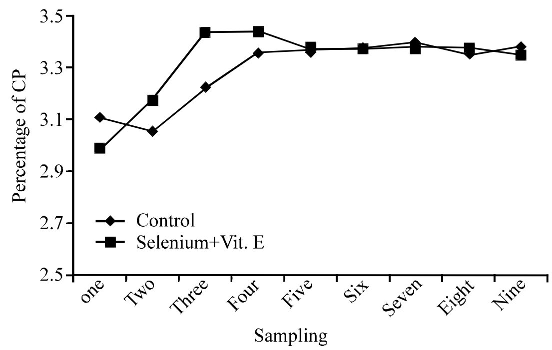

Fig. 3: Effects of Se and Vit. E supplementation on percentage of CP in Ayshire first lactation cows

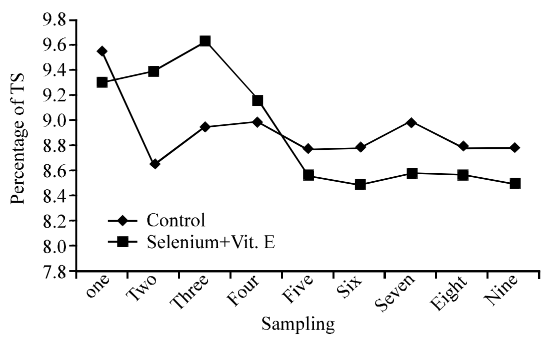

Fig. 4: Effects of Se and Vit. E supplementation on percentage of TS in Ayshire first lactation cows

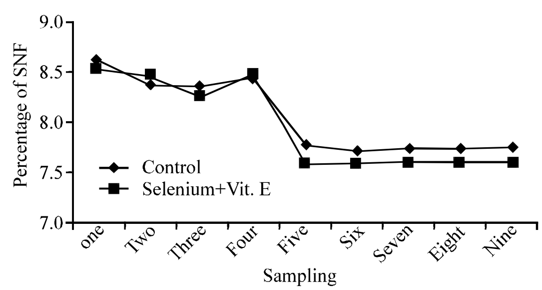

Fig. 5: Effects of SE and Vit. E supplementation on percentage of SNF in Ayshire first lactation cows

and TS (Table 1). The relative variation of the data analyzed and represented by its coefficient of variation percentage values were 11.28, 11.95, 13.53, 10.49 and 22.44%. For the variable represented in the SCC (Fig. 7), milk from cows of control (T1) recorded a greater number ($p<0.05$) of somatic cells treatment two (2.053 vs. 1.509). The subjective assessment of BCS understood this as a nutritional assessment of physical condition of the animal is shown in Fig. 8. Both treatments have practically the same values ($p>0.05$) which vary in the range of 2.5-3.0 standing near the desirable values for animals in

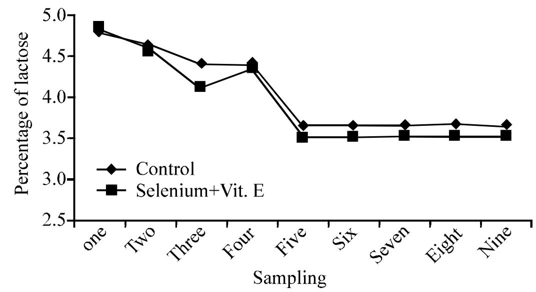

Fig. 6: Effects of SE and Vit. E supplementation on percentage of lactose in Ayshire first lactation cows

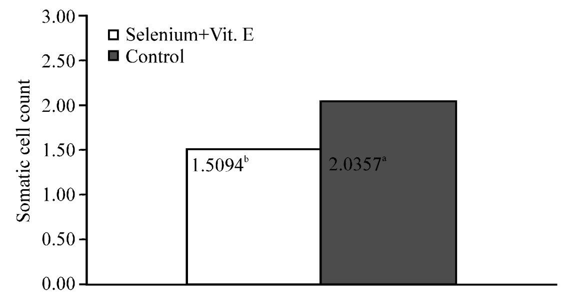

Fig. 7: Effects of Se and Vit. E supplementation on SCC of first lactation Ayrshire cows

Table 1: Effects of selenium and vit. E supplementation on monthly milk composition of Ayrshire first lactating cows

Treatment	Fat	CP[1]	TS[2]	SNF[3]	Lactose
Selenium+Vit. E (T1)					
Sampling one	3.156[b]	2.986[c]	9.306[a]	8.523[a]	4.837[a]
Sampling two	3.205[b]	3.179[b]	9.386[a]	8.452[a]	4.573[a]
Sampling three	3.425[a]	3.443[a]	9.673[a]	8.251[a]	4.109[a]
Sampling four	3.037[b]	3.448[a]	9.168[a]	8.488[a]	4.340[a]
Sampling five	3.246[a]	3.373[a]	8.558[b]	7.581[a]	3.508[a]
Sampling six	3.225[b]	3.380[a]	8.485[b]	7.602[a]	3.517[a]
Sampling seven	3.210[b]	3.385[a]	8.574[b]	7.597[a]	3.535[a]
Sampling eight	3.212[b]	3.380[a]	8.569[b]	7.590[a]	3.528[a]
Sampling nine	3.236[a]	3.358[a]	8.502[b]	7.600[a]	3.531[a]
Means	3.209[a]	3.333[a]	8.941[a]	8.87[a]	4.105[a]
Control (T2)					
Sampling one	3.206[b]	3.106[b]	9.556[a]	8.594[a]	4.787[a]
Sampling two	2.819[c]	3.055[b]	8.657[b]	8.373[a]	4.616[a]
Sampling three	3.037[b]	3.226[b]	8.955[b]	8.333[a]	4.406[a]
Sampling four	3.005[c]	3.358[a]	8.995[b]	8.447[a]	4.388[a]
Sampling five	3.291[a]	3.366[a]	8.776[b]	7.774[a]	3.637[a]
Sampling six	3.294[a]	3.377[a]	8.786[b]	7.713[a]	3.655[a]
Sampling seven	3.308[a]	3.406[a]	8.990[b]	7.734[a]	3.660[a]
Sampling eight	3.316[a]	3.351[a]	8.794[b]	7.744[a]	3.668[a]
Sampling nine	3.301[a]	3.386[a]	8.788[b]	7.754[a]	3.659[a]
Means	3.177[a]	3.284[b]	8.931[a]	7.995[b]	3.964[b]
n	1533.000	1567.000	1567.000	1567.000	1567.000
CV	11.280	11.950	13.530	10.490	22.440

[1]Protein crude; [2]Total solids, [3]Non fat solids

production. However, there was a decrease in the BCS of cows in T1 (control). The higher MP obtained during the duration of this investigation by the cows in the group

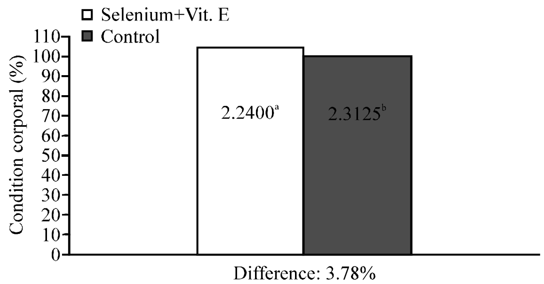

Fig. 8: Effects of Se and vitamin E supplementation on BCS of first lactation Ayrshire cows

supplemented with SE and vitamin E compared with the control group may be as a result of the selenium effect on the immune response in animals since, it is an essential component of glutathione-peroxides enzyme that catalyzes the oxidation of reduced glutathione (Cordova-Izquierdo *et al*., 2010). The reduced glutathione protects the liquids from the membrane and other cellular constituents against oxidative damage (Rotruck *et al*., 1973), affecting the health of the dairy cow due to their close relationship and effect on the health of the mammary gland (Juniper *et al*., 2006). The benefits of supplementing Se and vitamin E in the animal's diet is a common finding and could be related to their mechanisms of antioxidant effects (Jukola *et al*., 1996). Milk production is directly influenced by the animal's general health and by the health of the mammary gland as well as environmental conditions such as inadequate nutrient intake, low corporal condition and intensity of the production system (Butler, 2000). Although, significant differences ($p<0.05$) were found on averaged percentage of CP, SNF and milk lactose content, these findings do not represent important biological or commercial increments.

On the other hand, no statistical significant difference in percentage of fat and TS content was found. The quality of milk can be explained by its physicochemical composition, organoleptic and microbiological qualities. Previously only the fat content and density of milk were used as quality criteria, currently the content in fat, protein and solids non fat are combined. In most developed countries the quality of milk is defined by the SCC and bacterial count of raw milk tanks (Ruegg and Tabone, 2000). The values obtained for both treatments were 1.5094 for the supplemented cows compared with control cows (2.0537) that represent a value between 25,000 and 50,000 cells mL^{-1} which corresponds to a healthy animal with no problems in its mammary gland. Decreased SCC because of Se and vitamin E supplementation has been reported in first lactation heifers (Smith *et al*., 1997). The SCC expresses an state of inflammation of the udder allowing us to have an idea on the functional status and health of the mammary gland and milk composition therefore, it is a very important quality criterion (Sarikaya and Bruckmaier, 2006). Healthy animals have from 100,000 to <200,000 milk somatic cells mL^{-1} on the other hand, animals that are considered sick are those that produce >200,000 somatic cells mL^{-1} (Bradley and Green, 2005). The cell count values are a function of the prevalence of intra-mammary infections within the herd and are a key indicator of the milk's quality (Wenz *et al*., 2007). Changes in BCS were not affected by treatment.

Average weight was statistically similar in the experimental groups although, a non significant trend of losing weight in control cows grater than cows supplemented with Se and Vit. E was observed; this could be a result than the selenomethionine not used in the seleniumproteins synthesis could be utilized by the organs and tissues with high rates of protein synthesis such as skeletal muscle, erythrocytes, pancreas, liver, kidney, stomach and gastrointestinal mucosa (Schrauzer, 2000). The non statistical difference in BCS between treatments may indicate that selenium and vitamin E had no effect on fat accumulation and body tissue of lactating animals which is consistent with Espinoza-Villavicencio *et al*. (2010).

CONCLUSION

The incorporation of Se and vitamin E in diets of first lactation Ayshire cows under grassing systems increases milk production and improves chemical composition of milk, reduces SCC and has no effect on BCS. The performance and economic feasibility of the use of selenium plus vit. E allowed us to obtain a profit margin of $0.21 (US cents) per animal per day in this study.

REFERENCES

Ali, A.K.A. and G.E. Shook, 1980. An optimum transformation for somatic cell concentration in milk. J. Dairy Sci., 63: 487-490.

Bradley, A. and M. Green, 2005. Use and interpretation of somatic cell count data in dairy cows. Practice, 27: 310-315.

Butler, W.R., 2000. Nutritional interactions with reproductive performance in dairy cattle. Anim. Reprod. Sci., 60-61: 449-457.

Cordova-Izquierdo, C.G.R.L., V.M.X. Campos, S.C. Suarez, C.A. Cordova-Jimenez and M.S. Cordova-Jimenez *et al*., 2010. Effect of Gonadotropin-Releasing factor (GnRH) and antioxidants on the rate of estrous repetition dairy cows. Aust. J. Basic Applied Sci., 408: 1282-1287.

Espinoza-Villavicencio, J.L., R. Ortega-Perez, A. Palacios-Espinosa and A. Guillen-Trujillo, 2010. Effect of fat supplementation on production characteristics, pregnancy rates and some lipid metabolites in beef cows grazing. Arch. Med. Vet., 42: 25-32.

Goering, H.K. and P.J. van Soest, 1970. Forage Fiber Analysis. Agriculture Handbook No. 79. Agricultural Research Service, USDA., Washington, DC., USA.

Jukola, E., J. Hakkarainen, H. Saloniemi and S. Sani, 1996. Blood selenium, Vitamin E, Vitamin A and β-carotene concentrations and udder health, fertility treatments and fertility. J. Dairy Sci., 79: 838-845.

Juniper, D.T., R.H. Phipps, A.K. Jones and G. Bertin, 2006. Selenium supplementation of lactating dairy cows: Effect on selenium concentration in blood, milk, urine and feces. J. Dairy Sci., 89: 3544-3551.

Koc, A. and K. Kizilkaya, 2009. Some factors influencing milk somatic cell count of Holstein Friesian and Brown Swiss cows under the Mediterranean climatic conditions. Arch. Tierz., 52: 124-133.

Koc, A., 2008. A study of somatic cell counts in the milk of holstein-friesian cows managed in mediterranean climatic conditions. Turk. J. Vet. Anim. Sci., 32: 13-18.

Rhone, J.A., S. Koonawootrittriron and M.A. Elzo, 2008. Factor affecting milk yield, milk fat, bacterial score, and bulk tank somatic cell count of dairy farms in the central region of Thailand. Trop. Anim. Health Product., 40: 147-153.

Rotruck, J.T., A.L. Pope, H.E. Ganther, A.B. Swanson, D.G. Hafeman and W.G. Hoekstra, 1973. Selenium: Biochemical role as a component of glutathione peroxidase. Science, 179: 588-590.

Ruegg, P.L. and T.J. Tabone, 2000. The relationship between antibiotic residue violations and somatic cell counts in wisconsin dairy herds. J. Dairy Sci., 83: 2805-2809.

Sarikaya, H. and R.M. Bruckmaier, 2006. Importance of the sampled milk fraction for the prediction of total quarter somatic cell count. J. Dairy Sci., 89: 4246-4250.

Schrauzer, G.N., 2000. Selenomethionine: A review of its nutritional significance, metabolism and toxicity. J. Nutr., 130: 1653-1656.

Schwarz, K., 1974. Recent dietary trace elements research, exemplified by tin, fluorine and silicon. Fed. Proc., 33: 1748-1757.

Smith, K.L., J.S. Hogan and W.P. Weiss, 1997. Dietary vitamin E and selenium affect mastitis and milk quality. J. Anim. Sci., 75: 1659-1665.

Spilke, J., N. Mielenz, S. Krause and L. Schuler, 2009. Statistical modeling for growth data in linear mixed models: Implications derived from an example of a population comparison of golden hamsters. Arch. Tierz, 52: 85-105.

Talafha, A.Q., S.Q. Lafi and M.M. Ababneh, 2009. The effect of estrus synchronization tratments on somatic cell count of transitional-anestrus Awassi ewes milk. Trop. Anim. Health Prod., 41: 161-170.

Tufarelli, V., G.M. Lacalandra, G. Aiudi, F. Binetti and V. Laudadio, 2011. Influence of feeding level on live body weight and semen characteristics of Sardinian rams reared under intensive conditions. Trop. Anim. Health Prod., 43: 339-345.

Wenz, J.R., S.M. Jensen, J.E. Lombard, B.A. Wagner and R.P. Dinsmore, 2007. Herd management practices and their association with bulk tank somatic cell count on united states dairy operations. J. Dairy Sci., 90: 3652-3659.