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# Milk production and sustainability of the dairy livestock systems with a high calving concentrate pattern at the early spring

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## Resumen

Los resultados fueron obtenidos de la informacion de 210 fincas lecheras con alta concentración de partos al inicio de la primavera (60-80% de los partos anuales) y se encontraron efectos importantes en la produccion de leche y menores volumenes de combustible/1000 kg de leche producida que en los patrones menos concentrados de los restantes sistemas lecheros. Las respuestas en produccion de leche fueron mayores en un rango de 21 506 kg a 46 250 kg respecto a los otros sistemas con un patron mas irregular. Los costos operacionales disminuyeron entre 29.7% a 35.1% en los sistemas mas concentrados. Los resultados de diferentes indicadores de sostenibilidad de los sistemas mas concentrados indican mayor eficiencia, con uso de menos suplementos, costos energeticos reducidos/ kg de leche/ vaca y por ha y menos calentamiento global por emisiones reducidas de metano entre 31-27% y una mejor relación concentrado-forrajes que en los restantes sistemas. Los balances de nitrógeno se encontraron en un rango de –7.2 kg/ha/año a 16.4 kg/ha/año y valores de 14-29 % y 11-36% de descarga de Azufre (S) y

Fósforo (P) al ambiente. Los patrones de parición concentrada al inicio de lluvias tuvieron mayor eficiencia bio-económica y sostenibilidad que los otros sistemas lecheros en el año.
**Palabras clave:** Vacas, estación del año, pastoreo, rendimiento lácteo, economía, ambiente,

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**Abstract**

A research was development with the objective to evaluate the effects of different factors that affect the efficiency of the calving concentrate pattern at the early spring dairy systems in Cuban since 1988 until 2013. The results were obtained for the information of 210 dairy farms with high concentration of calving in early spring (60-80% of calving of annual) and find an important effects on more milk production and minor quantities of fuel oil consumed /1000 kg of milk produced than non concentrate calving pattern dairy systems. In theses cases the responses on milk production was great in the range of 21506kg to 46250kg respect to others. The operational costs were diminished in all time with pattern of early spring calving on 35.1% - 29.7%. The results reached, with low supplements, minor energy costs per kg of milk produced per/cow and ha with high calving concentration in spring respect to the others systems with disorder in calving pattern are superior. The global warming potential (GWP) in the systems with high concentration of calving in early spring was approximately 31-27 % minor the methane production based in more better Forage-Concentrate relation (81% forages-19% concentrates) in the feed than the others systems, and positives balances of Nitrogen with values of –7.2 kg./ha./year to16.4 kg./ha./year and values of 14-29 % and 11-36% of minor discharge of the Sulfur (S) and Phosphorus (P) to the environment respectively than confirm the sustainability of the seasonal milk production systems in Cuban dairy farms conditions.

**Key words:** Cows, season, grazing, milk yields, economy, environment

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## Introduction.

The dairy livestock systems in the tropics are very important like way of life for many peoples and per milk and dairy products for human health. In this socio-economic and environment context is necessary increase the efficiency of the dairy systems and reduce the discharge of pollutants to the atmosphere, soil and vegetation (Holmes, 2006; Guevara et al., 2007).

A feasible alternative for dairy production with grazing cows in low inputs conditions in Cuba and others zones of tropics and subtropics is the seasonal milk production systems and obtain a low operational costs and sustainability

of the whole dairy systems since the farmers until dairy factory and consumers, in this sense the objective of article is evaluate the efficiency of the calving concentrate pattern at the early spring dairy systems in Cuban conditions measured like milk production, global warming potential, total energy balance and sustainability in the principal dairy basin of the country.

## Materials and Methods.

For evaluate the effects of different factors that affect the efficiency of the calving concentrate pattern at the early spring dairy systems in Cuban conditions since 1988 until 2013 measured like milk production, global warming potential, total energy balance and sustainability in the principal dairy basin in Camagüey at the east of Cuba, was make a big research that is supported per many thesis on diploma, master and doctoral levels and were used four software.

The indicators of agro-environment sustainability were calculated for methane and others indicators like N, P, S, energy and land for milk production and GWP for the methods of Cederberg and Mattsson (2000) and Clark (2001). The emissions were estimated using a whole farm GHGs models, based on the Intergovernmental Panel on Climate Change (IPCC, 2010) methodology with a yearly time-step.

Emissions of CO2, CH4 and N2O were summed based on their equivalence factor in terms of CO2-equiva-lents (CO2-e; 100-year time horizon): 1 for CO2, 25 for CH4 and 298 for N2O. There was an coefficient of emission in kg $CO_2$-eq. per kg energy corrected milk (ECM) in the spring calving system (1.27) compared to conventional (1.20).

The results were obtained for the information and comparison for different indicators of 210 dairy farms with high concentration of calving in early spring with 60-80% of the annual calving with the use of some approaches like, forages and feeds budgets, partial budgets for many technological changes and statistical package SYSTAT 7.0

## Results and Discussion.

Find important effects on more milk production and minor quantities of fuel oil consumed /1000 kg of milk produced than non-concentrate calving pattern dairy systems (Table 1). In theses cases the responses on milk production was great in the range of 21506kg - 46250kg respect to others non seasonal milk production dairy systems, and in some studies of cases on seven years the different responses reached 22 725 kg with 81% of calving occurred in the spring with 65.2% in the first eight weeks of this period. This results are coincident with many experiences in countries that seasonal calving systems

like New Zealand, South Australia, some regions of the USA, and Argentina and Uruguay, but the levels of milk productions in our case are lows (Holmes; 2006; Zotto et al., 2009; Kristensen et al., 2011; Flysjö et al. 2012; Guevara et al., 2012; Sarhan, 2013).

FAO (2013) show that emissions of methane and others polutants per kg of milk declined exponentially as annual milk production per cow increased based on this report Gerber et al.,(2013) concluded that increasing annual milk production per cow could lower emissions of GHGs in systems with a low milk yield per cow, such as non concentrate annual calving systems.

**Table 1.** Influence of calving concentration in spring season over the efficiency of milk production in dairy farms in Camagüey, Cuba.

| Indicators of dairy farms | Seasonal calving pattern |
|---|---|
| Range of response in milk production (kg) respect to year around milk production systems | **21506 - 46 250** |
| Levels of fuel oil reduced / 1000 kg of milk produced (l) | **104 - 213** |
| Dairy operational costs reduction respect to year around milk production (%) | **35.1-29.7** |
| Returns to the operational capital (%) | **26.2-15.8** |

The operational costs were diminished in all time with pattern of early spring calving on 35.1% - 29.7%, and it was an important factor because the low expenses in concentrate feeds. In many research on milk production from pastures with seasonal calving patterns, this variant reached low costs respect to non concentrate calving because minor expenses in concentrate for feeding (Phetteplace et al.,2001; Holmes, 2006; Peters et al., 2007; Capper et al., 2009; Guevara et al., 2012; Zehitmeier et al., 2012).

**Table 2.** Influence of calving concentration in spring season in some indicators of agro-environment sustainability of dairy farms in Camagüey, Cuba.

| Indicators of dairy farms | Seasonal calving pattern |
|---|---|
| Reduction in the use of concentrates (%) | **15 - 33** |
| Reduction in the use of energy/kg of milk production (%) | **26 - 39** |
| Reduction in global warming potentials calculated like methane emission(%) | **27- 31** |
| Range of nitrogen balance (kg/ha/y) | **7.2-16.4** |
| Reduction in S output discharged (%) | **14-29** |
| Reduction in P output discharged (%) | **11-36** |

The results for indicators of agro-environment sustainability on pattern of major efficiency reached, with low supplements, minor energy costs per kg of milk produced per/cow and ha in the systems with high calving concentration in

spring respect to the others systems with disorder in calving pattern, where is required more land/kg.

The global warming potential (GWP) in the systems with high concentration of calving in early spring was approximately 31-27 % minor the CO2-Methano production based in more better Forage-Concentrate relation (81% forages-19% concentrates) in the feed than the others systems, and positives balances of Nitrogen with values of –7.2 kg./ha./year to16.4 kg./ha./year and values of 14-29 % and 11-36% of minor discharge of the Sulfur (S) and Phosphorus (P) to the environment respectively. The necessary energy in whole systems with high concentration of calving in early spring patterns was 26-39 % minor than the others dairy systems and confirm the sustainability of the seasonal milk production systems in Cuban dairy farms conditions.

In coincidence with the study, Peters et al., (2007) and Kristensen et al (2011) report an schematic overview of the hotspots of the LCA analysis and Sarhan (2013) studies describing emissions from dairy calf to beef production systems which are generally much lower than those in no pattern calving cow systems as a result of cow GHG emissions being mostly allocated to milk production for dairy systems.

In accordance with these findings (Flysjö et al. 2012) in the study of the link between milk and beef production in LCA and CF studies of milk it is assumed that the meat from dairy cow and the raised dairy calf replaces are less efficient. Cederberg and Mattson, (2000) and Cederberg and Stadig (2003) and Kilelu et al.,(2013) reports that the production of from a cow-calf system in Europe emits 0.14 kg CO2-eq/0,05 kg of animal protein, which is more than the difference between of the two production systems evaluated (1.18 kg $CO_2$-eq for the conventional system and 1.03 for the spring calving concentration systems).

The spring calving pattern dairy systems analyzed in this study emit fewer greenhouse gasses per unit milk than predicted by Phetteplace et al. (2001), which predicted emissions minors of 1.09 kg CO2-eq/kg milk, in others environments Capper et al. (2009) calculated emissions of the U.S. Dairy industry to be 1.35 kg CO2-eq per kg milk, focusing on conventional production. The spring calving grazing system in this study emits less net greenhouse gas with lower climate change potential per kg energy corrected milk (ECM) than the conventional system by percent, and the combination system emits 0.7 percent less than the conventional system, it was coincident with finds of Herringshaw (2007) in some dairy systems different for intensity and inputs in USA and Zotto et al., (2009) in New Zealand.

## CONCLUSIONS:

The influence of the calving concentration at the start of spring in Cuban dairy farm was great in the principal indicators of milk production and high than the around year milk production systems and additionally have a good impacts in others items like use of land, energy and the N, P and S balance and can reduce the methane emissions in the time, with great possibilities of conservation of natural resources.

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