Unlocking the Potential within Puerto Rico's Milk Industry

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The milk output of the Puerto Rican dairy industry has remained static over the last 30 years, despite improvements in the genetics of cows. With the quality of forage being a key limitation to milk production on the Island, **Dr Teodoro Ruiz** and his team from the University of Puerto Rico have been investigating the effects of alternative forage crops on milk yield. They are also evaluating the productivity of Puerto Rican 'pelón' Holstein cows, with the overall aim of developing strategies to improve milk production under tropical conditions.



Milk is the most important agricultural commodity in Puerto Rico, accounting for at least 23% of total gross annual income. However, the average daily milk yield of lactating cows on the Island has not increased for decades, whereas in continental US, milk yields have shown consistent annual increases and are now estimated to be more than double those achieved in Puerto Rico.

Traditionally, the dairy industry in Puerto Rico has depended on grazing tropical grasses to supply the forage needs of lactating cows. Over the years, a drastic reduction in grazing area and increased stocking rates have caused pasture availability for grazing milk cows to decline to about 0.12 hectares per cow. This has prompted dairy farmers to use increasingly higher levels of commercial dairy concentrates, such as low-quality tropical grass hays, to supplement the dietary fibre intake of lactating cows. The use of concentrates to feed dairy cows also has detrimental effects on the local environment, with studies showing that dietary phosphorus concentrations from such feed can exceed nutritional recommendations by more than 60%. Intensively managed dairy farms in Puerto Rico are suspected of being important contributors of phosphorus in runoff – leading to contamination of surface waters.

Over the past decade, the Puerto Rican dairy industry has been mired in an economic crisis affecting most of its producers. This crisis has been brought about primarily by an increase in concentrate feed costs, and the impossibility of further raising the milk price to compensate for increased production costs.

Despite these problems, the dairy industry remains the principal agricultural enterprise on the Island. However, milk production has remained largely unchanged – meaning a reduction in milk production efficiency due to increased production costs, and a significant reduction in pasture land in



milk production regions. Furthermore, there has been a reduction in the total number of farms, and an increase in the proportion of medium and large dairies, which tend to rely less on grazing and feed more conserved forages than smaller dairies.

Motivated by the need to reduce reliance on concentrate feeds within dairy farms, Dr Teodoro Ruiz at the Mayagüez Campus of the University of Puerto Rico set about investigating a range of alternative forage crops that could be successfully grown in tropical conditions.



In parallel with this work, his team has also been evaluating the productivity of Puerto Rican 'pelón' Holstein cattle, when fed higher quality forages. 'The short-hair or "slick" gene found in these animals provides them with greater physiological tolerance to heat stress,' explains Dr Ruiz. 'We hope to determine whether these characteristics could make "pelón" Holsteins a part of the solution to Puerto Rico's static milk production problem.'

Identifying Promising Forage Crops

The milk industry in the drier coastal regions of Puerto Rico relies mostly on low-quality bluestem grass for forage, with fewer and smaller areas dedicated to buffell, Bermudagrass and pangola grass. However, despite climatic limitations there is the potential to produce high-quality forage in tropical conditions. At the University of Puerto Rico's Agricultural Experiment Station, Dr Ruiz and his team have been working to evaluate alternatives to these lowquality forages, focusing on the legumes Rhizome Perennial Peanut (RPP) and perennial soybean, and the Pennisetum 'maralfalfa'.

As part of this work, Dr Ruiz and his colleagues have evaluated various cultivars of RPP, finding it to have excellent adaptability and yield potential in the semi-arid coastal plains, under irrigation. The variety 'Henorico' is the tallest and most productive variety evaluated by the team and the highest yields for this variety exceed those of most grasses grown in the area. Its crude protein content is comparable to that of imported alfalfa hay and exceeds all local grass hays when evaluated at the same maturity.

'In terms of practicality, the establishment of RPP is very labour intensive, due to the fact that it must be planted using rhizomes,' says Dr Ruiz. 'However, subsequently, the maintenance costs of established stands are very low, and at our Agriculture Experiment Station, the RPP stands that we've planted have remained productive for more than 15 years, with very low management inputs required.'

Unlike other legumes such as alfalfa, RPP is persistent and productive under a wide range of soil types. Moreover, its production is environmentally friendly because it requires little or no chemical applications. Being a legume, it does not require regular fertilisation for sustained production, and for all practical purposes, it is disease and pest free under tropical conditions.

The research team has also identified perennial soybean as a legume of potential high-quality for use with dairy cows in Puerto Rico, as it appears to have excellent adaptability to the arid southern coastal plain of the Island. It can be harvested as hay or grazed, and grows well in a variety of fertile and unfertile clays and soils. It is also a very drought-tolerant species and recovers once favourable conditions resume. However, it has a higher demand for several nutrients, especially phosphorus, potash and molybdenum,



than other tropical legumes and cannot tolerate very acidic soils or waterlogged conditions.

In the team's trials, maralfalfa produced large amounts of edible dry matter and exhibited excellent digestibility. 'Local farmers have been utilising maralfalfa grass to feed their dairy animals for several years without reliable research information,' explains Dr Ruiz. 'Its use and propagation have been motivated by anecdotal information and testimonials from other dairy farmers.' As a result of their studies, Dr Ruiz and his team have concluded that maralfalfa is a high-yielding grass, well adapted to the tropical environment, and could serve as an alternative to sorghum in dairy production systems in the Caribbean.

Developing Well-Adapted Dairy Herds

Alongside studying forage crops with the potential for increasing milk production in Puerto Rico, Dr Ruiz and his team have also been working to evaluate the possibilities of utilising local 'pelón' Holstein cows to boost milk production on the Island. The short-haired ('slick') genotype exhibited by 'pelón' cows was first identified around 20 years ago in Puerto Ricanbred Holsteins, and it is believed that this dominant gene was introduced from Creole cattle many generations ago.

Initial data collected by the University of Puerto Rico research team suggests that 'pelón' cows are better adapted than traditional Holsteins to heat-stress conditions, under which they show more efficient heat dissipation and lower rectal and vaginal temperatures. In addition, genomic evaluation has provided preliminary evidence of the superiority of 'pelón' Holsteins in terms of milk production and reproductive performance over traditional Holsteins in the tropics. Most recently, efforts at the University's dairy farm have concentrated on mating through artificial insemination to increase genetic diversity and study the potential for improved milk production in these cattle. To increase the number of these animals, Dr Ruiz and his team have been working with two local dairymen who own registered 'pelón' Holstein bulls and cows.

'Genetic analysis has demonstrated that the University's 'pelón' herd now has the best and most varied pool of all the herds with identified 'pelón' Holsteins on the Island, with around 22% of our herd having been identified as possessing the 'pelón' genotype,' says Dr Ruiz. 'Our study now aims to evaluate milk production and the dry matter intake of these 'pelón' Holsteins when managed both in a grazing system, and when subjected to improved nutrition, to determine the breed's response to higher quality forage.'

The Future for Milk Production in Puerto Rico

The work of Dr Ruiz and his team demonstrates that alternative forage crops could play an important role in the future of dairy farming in Puerto Rico. Indeed, to prevent future instability within Puerto Rico's dairy industry, Dr Ruiz believes that it will be necessary to maximise the productivity and quality of local forages, to reduce dependency on concentrates, and maximise the efficiency of their use for milk production. 'Establishing a concentrate supplementation strategy that will allow for efficient milk production by dairy cows grazing tropical forages should maximise pasture utilisation, milk production, and minimise concentrate intake,' he says.

To develop such a strategy, his team's next steps include evaluating the impact of the high-quality forages that they've identified on lactating cows on the Island. Dr Ruiz hypothesises that the inclusion of high-quality tropical forages such as Henorico RPP, perennial soybean and maralfalfa grass in dairy cows' diets could increase milk production by 5–10%. He also expects a similar increase in milk production from 'pelón' Holstein cows, compared to traditional Holsteins. Such changes could have positive environmental impacts, with lower stocking densities being required to meet milk quotas, and land being less intensively grazed. In addition, a reduced reliance on concentrates for feed could mean less pollution of surface waters, particularly in terms of phosphorus.

These combined positive effects on milk production and the local environment mean that the team's project has the potential to generate the first improvements in the Puerto Rican milk industry for more than 30 years, with further widespread implications for other countries throughout the tropics.



Meet the researcher

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Dr Teodoro Ruiz studied for his bachelor and master's degrees in Dairy Science at Louisiana State University, before going on to gain his PhD in Animal Science from the University of Florida in 1993. He is now a Professor within the Department of Animal Science at the University of Puerto Rico at Mayagüez. Dr Ruiz's research interests focus primarily on improving the quality and utilisation of forages in dairy cows' diets in the tropics, with the aim of overcoming nutritional limitations of the diets of lactating cows. He has also carried out research into local byproduct feeds as a source of fibre in the diets of dairy cows and management of nutrients within the dairy farm, particularly phosphorus and nitrogen.

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FURTHER READING

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