



ATSAF - CGIAR++ Junior Scientists Program Final Report

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Title: Fermentation products, nutritive values, and aerobic stability of fruit by-product silage using *Lactobacillus buchneri*

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As an international student at the University of Kiel learning about forage conservation, this gave me opportunities to explore this technology, especially the conservation of by-products which is plenty in my home country the Philippines. I was so grateful when the CGIAR++Junior Scientist Program of ATSAF accepted my Master's thesis proposal for funding and joined one of their CGIAR centers in South America, CIAT-Colombia under the supervision of Dr. Jacobo Arango, and with assistance from their laboratory coordinator, Dr. Johanna Mazabel. This collaboration gave me opportunities to work on exploring the conservation technology with fruit-by products as part of the feeding program for ruminants especially during drought or prolonged summer months where grass became limited for small-scale farmers.

On my first day in CIAT, they helped me explore the campus and meet the different researchers and laboratory technicians under the Tropical Forage Program that Dr. Jacobo was supervising. They gave me a short tour of the campus to locate the different facilities and amenities that I can do while in CIAT, and inside the Forage Quality Laboratory coordinated by Dr. Johanna where I did most of the analysis for my project. They discussed to me the operations inside their laboratory and some rules to follow especially in disposing of chemicals. We were able to finalize the materials needed for the project and the possible date to formally start the ensiling process.

Activities

I officially started in CIAT as a Visiting Researcher which was given to foreign student or researcher last June 13 for the purpose of conducting research on their program "Develop Research for the Conservation of Fodder and Agro-Industrial by-products through Silages". I attended several meetings and presentations with different supervisors and researchers that gave me insights into the main vision and mission of their research center, focusing on addressing the needs of their local farmers. These events influenced me on how my approach to my project should be, not only focusing on the success but thinking also if the procedure we developed can be adopted by local farmers, especially in my home country.

We performed preliminary experiments on ensiling pineapple by-products, as citrus by-products were limited during these times, and identified what adjustments could be made during these tests. These initial experiments helped us further understand the behavior of the pineapple by-products as it contained very high moisture and sugar,

and this was the first time that CIAT worked on agro-industrial by-products to be ensiled using bacterial inoculants as most of the research done here focused on different grasses and legumes. It was a great opportunity for us to learn together as well and brainstorm what could be added to the analysis that we performed.

Furthermore, I experienced working on-field and in the laboratory to learn the different activities done by their laboratory technicians like rumen fluid collection, fiber analysis, crude protein analysis, in vitro dry matter digestibility, and in vitro gas production test that was conducted on the latter days of my stay in CIAT as part of another project to determine the degradability and methane emission using grass and silage. It was a great opportunity for me to learn how to perform these analyses and to work on my samples independently.



Summary of the research

In ensiling pineapple by-products, we decided to use all the components namely crown, pulp, and peels that were collected freshly from a manufacturing plant. Oven drying was not an option as not all farms have drying facilities. With this adjustment, we used a combination of homofermentative and heterofermentative lactic acid bacteria as one of the treatments for the purpose of preventing possible mal-fermentation during the ensiling period. With the whole team working, we managed to ensile 64 bags each containing 1 kilogram of mixed pineapple by-products.



Pineapple by-products after compaction for ensiling.

One of the main objectives of my project was to determine the effect of the addition of bacterial inoculants as a silage additive in improving the aerobic stability of the pineapple by-products as this area was not yet explored by other studies concerning fruit by-products in general. Several procedures were performed and from the different consultations we made, we came up with the use of an insulator to prevent the possible effect of the environmental temperature on the drastic changes in the silage's temperature as shown in the picture below since we used only 300 grams of the sample to determine the aerobic stability.



Use of a polystyrene container (fabricated) to insulate the heat and a notch on the cover to allow airflow during the aerobic exposure of pineapple by-product silage.

These changes enabled us to determine at which time of the day (8:00, 12:00, 14:00, and 16:00) the silage became unstable after aerobic exposure as without the insulator, fluctuations of the silage temperature were observed.

One of the most interesting results we saw was the strong reduction in the pH after 7 days of ensiling. From a pH of 4.5 for the pre-ensiled material, even the control group reached a pH of 3.5 after 7 days and continuously became stable at the end of the proposed ensiling length of 75 days. These results gave us awareness that fruit by-products like pineapple that contain a lot of sugar can result in a very stable silage when ensiled completely anaerobic, without any worries of mal-fermentation.

Lastly, we observed that in 75 days of ensiling and with the combination of homofermentative and heterofermentative lactic acid bacteria, the silage was stable up to 78 hours after aerobic exposure. As we finalized all the observed data, the picture slowly became clearer on the possibility of adopting pineapple by-product silage with these bacterial inoculants not only on the silage quality but also on the stability upon opening and to be utilized by the animals.

Acknowledgment

I would like to thank ATSAF for this opportunity, and for accepting and funding my Master's thesis which allowed me to grow as a researcher and experience other cultures in CIAT-Colombia. Although we have differences in language, it did not hinder us in achieving our objective in this project. In addition, I want to send my sincerest gratitude to my supervisors at the University of Kiel, Prof. Dr. Uta Dickhoefer and Dr. Khaterine Salazar-Cubillas for the guidance during the application, experiment, and data analysis; and to Dr. Jacobo Arango and the Forage Quality Laboratory Team headed by Dr. Johanna Mazabel for assistance with the analysis during my stay in CIAT.



Forage Quality Laboratory Team (from left): Anyelo Mauricio, Liz Vanessa, Andrea Rosina, Dr. Lady Johanna, William David, Rona Cathrina, and Yeison Alexander.

Dios te Pague!