

## From Waste to Feed

Turning fruit and vegetable wastes into livestock feed: Sustainable feed resources with functional properties



### Background

Feed cost is the major expense in livestock farming. For many global south countries, conventional and market feeds are not always accessible and often not affordable for farmers. Pakistan is one of these countries facing the challenge. On the other hand, it is among the world's important producers and exporters of fruits and juice concentrates. Citrus, mangoes and apples are among the common fruits produced in Pakistan. Sugarcane and sugar beet are also important crops supplying raw materials for the sugar industry. As a result, there are massive amounts of by-product biomass coming from the food industry, which are usually considered wastes and disposed. In fact, such by-products could make an excellent feed for ruminants. These by-products not only contain nutrients but also bioactive compounds, many of which have been shown to support rumen health<sup>1-3</sup>. However, there are seasonal surges of by-products with short shelf-life. Thus, to enable an efficient utilization of those by-products in ruminant feeding, we need practical and inexpensive solutions for preserving them.



### Challenges

Drying and ensiling are the common ways to preserve feed. Both methods have advantages and challenges. Sun-drying is simple and cost-effective but requires plenty of outdoor space and field for drying. The weather has a big influence on the success. Indoor drying is easier to control but requires costly equipment, so that no small farms can afford the facility. Ensiling (lactic fermentation) is ideal for wet biomass with high sugar contents like fruit and sugary crop by-products. With the same principle applied, ensiling can be scaled according to the budget and equipment. It, however, requires knowledge and skills to create and maintain anaerobic stability or else it can easily lead to spoilage. We need to consider the heterogeneity in property and quality of by-products. Optimizing factors such as wetness, sugar content, oxygen removal and anaerobic stability can be a challenge.

1) Khiaosa-ard, R and Zebeli, Q, Journal of Animal Science 91: 1819-1830 (2013)

2) Kalantar, M, Archives of Animal Husbandry and Dairy Science 1-4 (2018).

3) Mahmood, M, Petri, R M, Gavráu, A, Zebeli, Q and Khiaosa-ard, R. Journal of the Science of Food and Agriculture 100: 2261-2271 (2020).

## Project objectives and activities

The project aims at exploring the potential use of fruit and vegetable by-products as ensiled feeds for ruminants, taking consideration of diversity in botanical species as well as the quality of by-products. This ongoing project is being conducted in three steps, beginning with experiment-size ensiling of different by-products, followed by a study of functional effects on rumen characteristics of ensiled products using the so-called 'Rumen Simulation Technique', and lastly the dissemination of the knowledge to academic and industrial fellows and potential users in Pakistan.

We focus on by-products of important crops of Pakistan and multiple factors that could influence the quality of the ensiled products. By-products of interest are apple pomace, mango peel, citrus pomace and sugar beet pulp produced after juice extraction. The variation of the quality of the by-products differing among industry and local vendors are also investigated. To maximize the recycling of agriculture waste and by-products, we use rice straw or sugarcane bagasse as the dry and fibrous materials for ensiling process. Also, storage stability is investigated. In beginning of the 2022, the project partners gathered in Pakistan to carry out the first research activities.

Phase II study will be carried out at the Austrian host institution. Here we will explore the added value of the ensiled by-products on modulating ruminal fermentation related to their bioactive compounds.

In the last phase of the project, we will hold a workshop to disseminate the project results and transfer the knowledge to the research community in Pakistan. The event will create the platform for the local research communities in Pakistan sharing the mutual goal in finding ways for sustainable use of food wastes as well as to attenuate the ever-growing competition between the use of resources directly for human nutrition or as feedstuffs for livestock.

We hope to stimulate the country's interest in research dealing with sustainability in livestock production and make further progress. In a long run, we wish to see a reduction of farm feed costs and improved farm efficiency while decreasing food-industry wastes.



Ensiled apple pomace (top panel) and citrus pomace (bottom panel) with rice straw or sugarcane bagasse

## Team



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Team's visit of a citrus juice plant and the collection of the by-product in February 2022