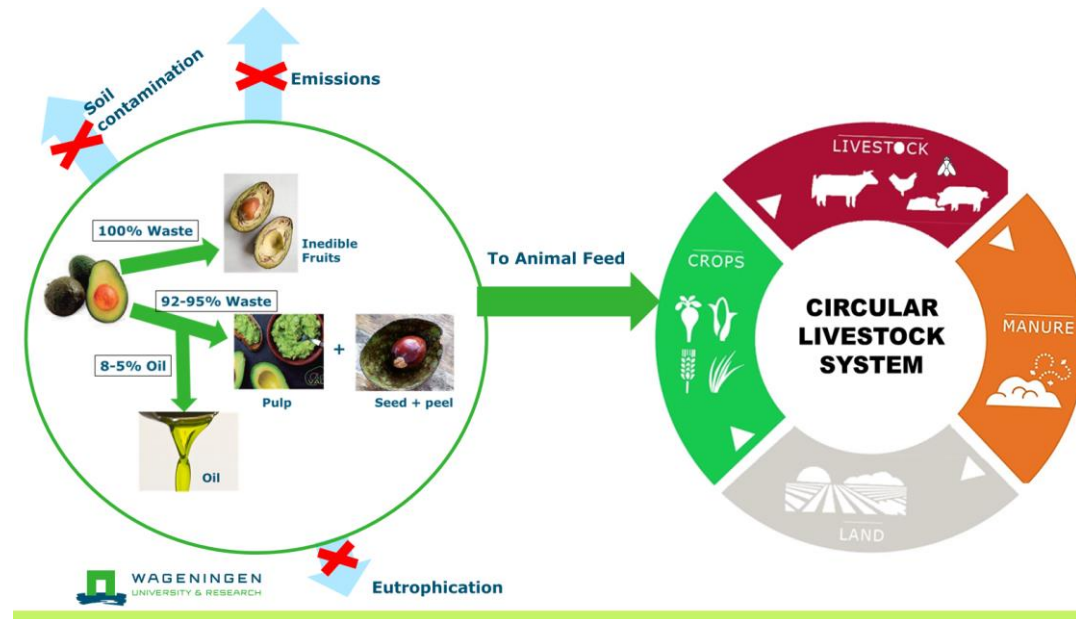


# Beyond Guacamole

## “Circular Solutions for Avocado Waste in Ethiopian Animal Nutrition”

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## Objective

- Understanding variations in nutritional value and antinutritional factors in avocado waste streams for livestock
- Developing a circular model that incorporates avocado-by-products into the Ethiopian animal feed industry

## Approach

1. Nutritional characterization of different avocado by-products
2. Identification of toxin levels (persin) of different avocado by-products
3. Identification of potential suppliers of avocado by-products
4. Estimation of potential inclusion levels of avocado by-products
5. Estimate economical benefits for feed industry

## Consortium:



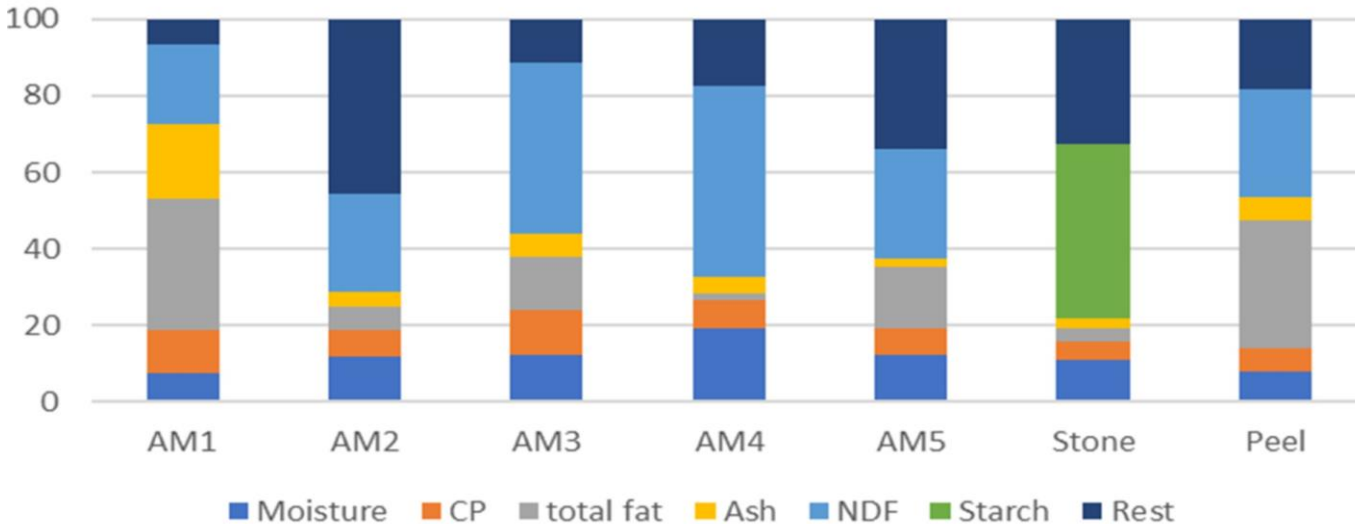
**Avocado processing facilities in Ethiopia, Kenya and NL**

**Ethiopian Feed Manufacturers Association**

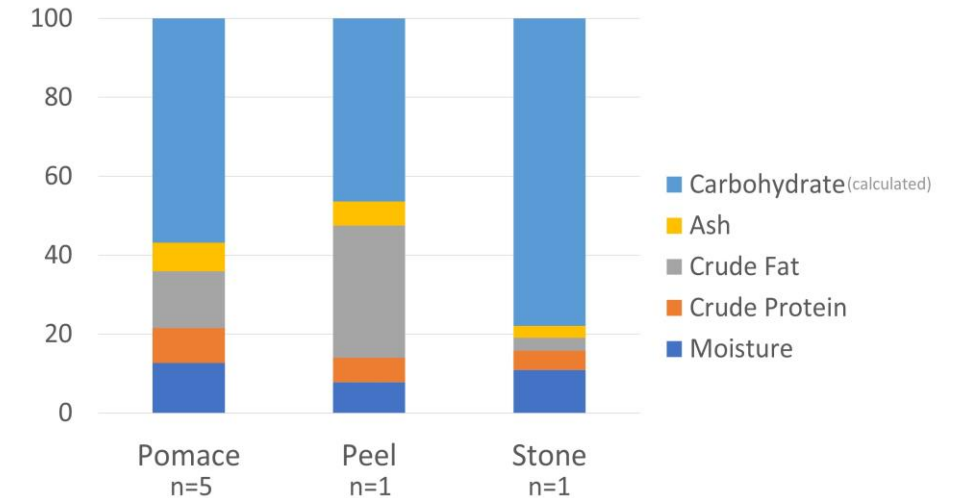
**Ethiopian Horticulture Producers Association**

# Results - Nutritional analysis

Chemical composition % as fresh weight



B) Chemical Composition (g/kg as is)

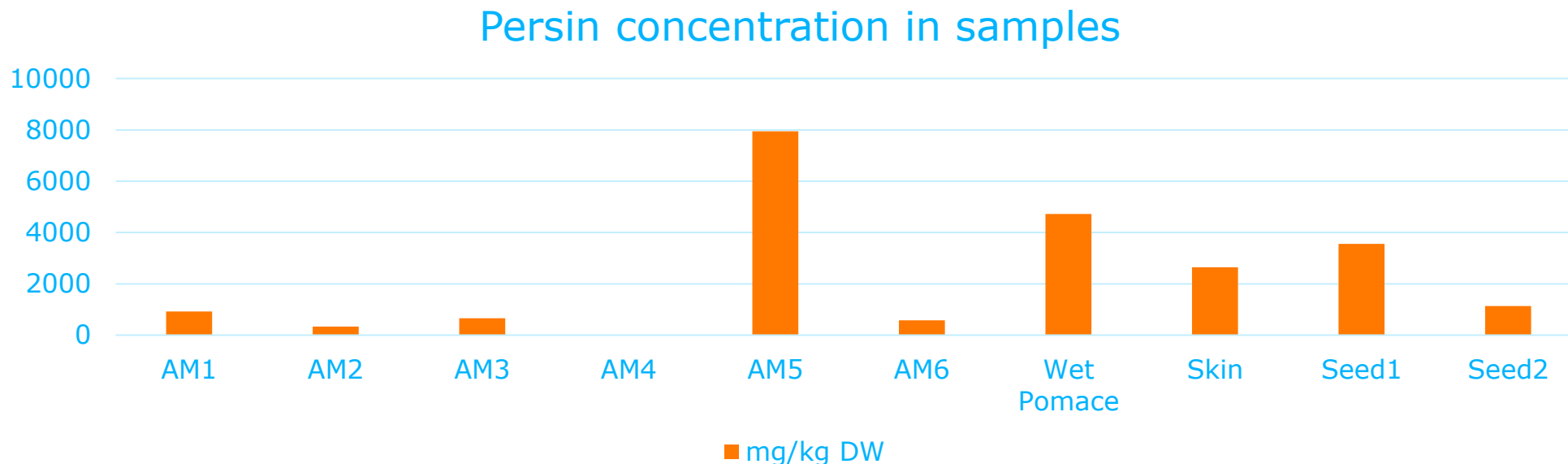


Chemical composition (g/kg as is) of different avocado meal (A), different avocado by-products (B) in this study

## Main conclusions from nutritional analysis:

- High variations among samples – especially in avocado meal (AM)
- In line with literature
- Provides potential for inclusion in feed for livestock
  - Seed provides starch, and meal provides fat, protein, and fibre
- NB analysis represents chemical composition → availability for livestock needs to be tested

# Results – Persin analysis



- **Persin is a fat-derived metabolite in avocado associated with a few cases of toxicity in livestock, and in lab-animals (mastitis & heart inflammation)**
- **Main conclusions from persin analysis:**
  - High variations → many factors affect the level of persin
  - Values are comparable to literature
  - Exact toxic doses of persin in different species not known / literature inconsistent
    - Up to 30% fresh or dried meal and/or seed did not cause health issues in poultry and pigs

# Results

## Potential of avocado-byproducts as feed

Component	Suitability	Description
Pomace (suitability)	• Yes	<ul style="list-style-type: none"> <li>• But limited by unsaturated fatty acids (ruminants)</li> <li>• Fat and fibre, and beneficial bioactive properties (pigs and poultry)</li> </ul>
Peel (suitability)	• Limited	<ul style="list-style-type: none"> <li>• Limited for cattle/pigs by lignin, persin, and other ANFs content</li> <li>• Not suitable for poultry due to lignin and persin, and other ANFs content</li> </ul>
Seed (suitability)	• Yes	<ul style="list-style-type: none"> <li>• Source of starch</li> </ul>
Persin levels	< 1g/kg DW	Exact toxic dose unknown, persin concentration in ETH pomace samples was below 1g/kg DW
Max inclusion levels (based on literature)	30% (W/W)	Based on seeds or meal in the diet
Replacement of ingredient (example)	wheat, cereals, maize	<ul style="list-style-type: none"> <li>• Energy/fibre sources such as wheat bran</li> <li>• Seed and meal can replace cereals and maize</li> </ul>

- Reduction in feed costs (replacing wheat bran/maize): between ~16.000-33.500 ETB/T (110-150 EUR/T)
- Also potential for feeding insects, degradation of persin & high quality protein production from waste

# Main Conclusions

## Avocado waste has high potential as alternative feed ingredient for animals

- Processing, drying of by-products & cultivar type influence nutritional & antinutritional components
- Variability of composition **is a challenge** for feed formulation
- Persin content not necessarily a limiting factor but needs to be taken into account
- Recommendations for oil extraction units to address these limitations
- Most potential for ruminants, poultry and gestating sows

## Economic and environmental benefits

- Reduction in feed costs of ~16.000 to 33.500 ETB per ton avocado-waste used (poultry/pigs/ruminants)
- Environmental benefit by replacing current ingredient used in feed formulation

## Feed trials need to confirm suitability & inclusion levels

- Nutrient digestibility, chemical and microbial safety, functional activities

# Next Steps

## By-products from fruit as feed ingredient in East-Africa

**Instrument:** Public-private-partnership project

### Objectives:

- Animal trials to confirm digestibility and suitability of the different avocado by-products
- Mapping the avocado value chain in East-Africa (identify potential stakeholders – beyond the current case-study in Ethiopia)
- Explore potential of other fruit waste as ingredients for animal feed (e.g. mango, banana, coffee)
- Identify best processing and preservation techniques

### Consortium:

- Alema Koudijs Feed plc & De Heus (Ethiopia, Kenia, Uganda...), Avocado processors, Soilmates, HAS

# Benefits for Alema Koudijs Feed plc (Ethiopia)



- **Business case**
  - Overview of suppliers, volumes and potential in Ethiopia
  - Potential to look further in the region, de Heus operations in East Africa.
- **Insight on Persin levels**
  - Allows De Heus to calculate inclusion levels per species
  - Starting point to make use of new RM
  - Follow up with feed trials
- **Ruminant potential**
  - Aim of increasing ruminant feed production, potential ingredient
- **Drying options**
  - Next step is to look together with suppliers in best drying techniques and increasing volumes



# THANK YOU

## Circular Solutions for Avocado Waste in Ethiopian Animal Nutrition



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