BOUNDARY BEND LIMITED

Evaluation of traditional and new processing aids for olive oil extraction

Research work funded by Rural Industries Research & Development Corporation

Pablo Canamasas & Leandro Ravetti

Boundary Bend Estate Processors Pty Ltd

BOUNDARY BEND LIMITED

Processing aids

- Substances that are used to facilitate the olive oil extraction process. They do not remain in the final product (they are not additives)

- Processing aids must not alter the chemical and organoleptic quality of the oil

- Objective: To evaluate the processing aids being used in other countries or studied in main research institutes in Europe

BOUNDARY BEND LIMITED

Legislation

- **Australian standard** (AS 5264-2011): “Olive oil is the oil obtained solely from the fruit of the olive tree (Olea europaea L.), to the exclusion of oils obtained using solvents or re-esterification processes and of any mixture with oils of other kinds”

- **Article 9.3**: “Processing aids are allowed to be used during the oil extraction process to the extent allowed by the *Australia New Zealand Food Standard Code”*

- ***ANZFA*** *(Section 1.3.3: Processing aids): Talc powder, Pectinase enzymes.*

BOUNDARY BEND LIMITED

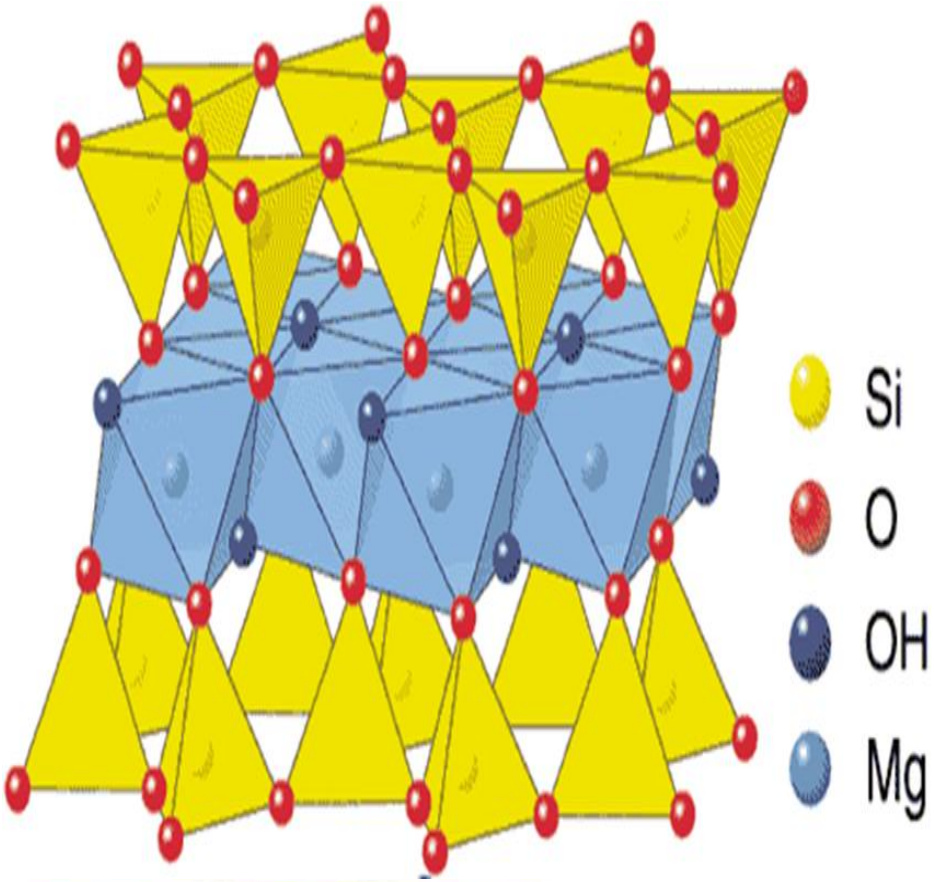
Processing aids & techniques

New aids	Traditional aids
o Talc powder o Enzymes o Water	o Microtalc powder o Common salt o Calcium carbonate o Enzymes with side activities o Warm water dipping o Ultrasound

BOUNDARY BEND LIMITED

Talc & Microtalc powder

- Magnesium silicate with high adsorption surface
- Lipophyllic nature: adsorbs oil droplets making them larger in size
- Provides structure to the paste in the malaxer
- It does not allow the paste to stick to the internal walls of the decanter



BOUNDARY BEND LIMITED

Talc & Microtalc powder

Talc powder

- Oldest powder used in the industry
- Magnesium silicate with high adsorption surface
- d50% = 8µm
- Specific surface area = 3.6 m2/gr
- Dose = 0.5-3%

Microtalc powder

- New product in the industry
- Same as talc powder, but finer particle size
- d50% = 2µm
- Specific surface area = 7.0 m2/gr
- Dose = 0.3-1%

BOUNDARY BEND LIMITED

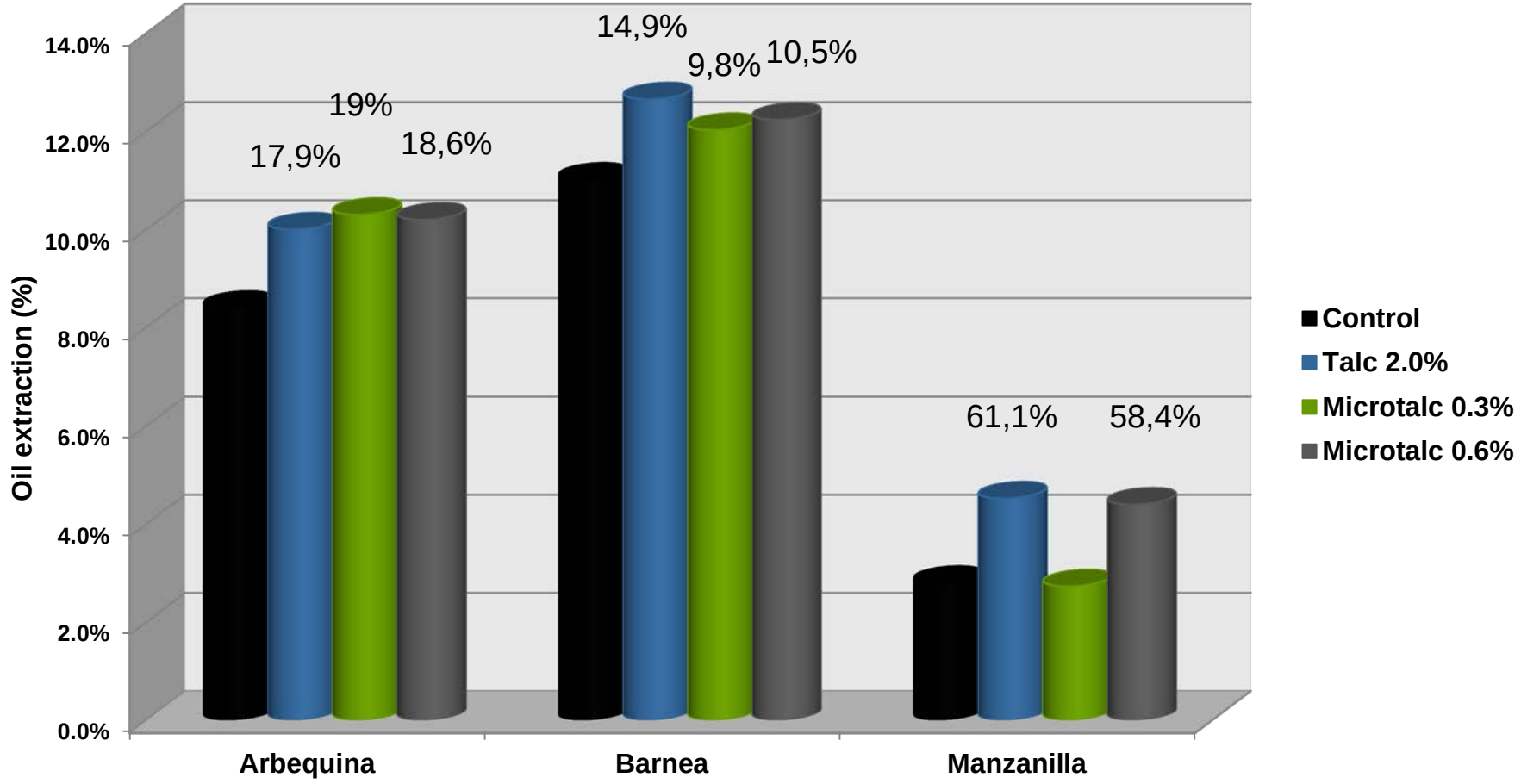
Equipment

BOUNDARY BEND LIMITED

Talc dispensers

BOUNDARY BEND LIMITED

Talc & Microtalc powder



BOUNDARY BEND LIMITED

Talc & Microtalc powder

- Beneficial impact on FFA, PV, K232, K270 & ΔK in Arbequina, Barnea & Manzanilla
- Higher PPH content in Barnea & Manzanilla
- No impact on taste or colour
- Microtalc powder seems to be more cost effective than talc due to less product transport, handling & storage

BOUNDARY BEND LIMITED

Talc powder

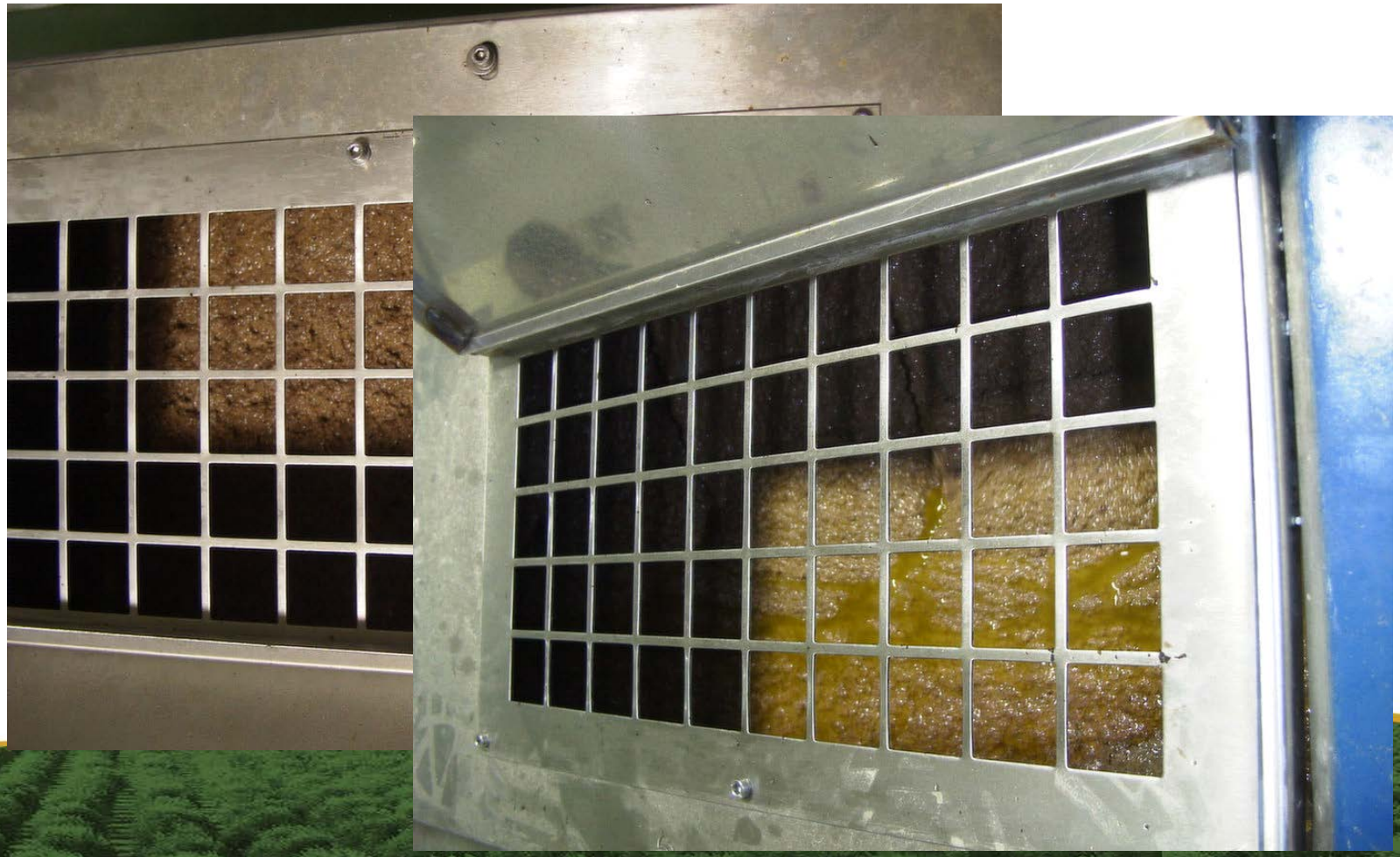
Talc trial in Manzanillo fruit with 61.1% moisture and 3.1 M.I.

Talc rate	Processing speed	Extraction efficiency
0.0%	2.95 tn/hr	74.36%
0.5%	3.45 tn/hr	81.25%
1.0%	3.90 tn/hr	86.34%
1.5%	4.15 tn/hr	88.35%
2.0%	4.15 tn/hr	89.15%
2.5%	4.15 tn/hr	88.74%

BOUNDARY BEND LIMITED

Talc powder

Talc trial in Manzanillo fruit with 61.1% moisture and 3.1 M.I.



BOUNDARY BEND LIMITED

Talc powder

When should I consider the use talc and how much of it?

- With difficult varieties (Arbequina, Leccino, Picual, Hojiblanca, Manzanillo).
- With high moisture levels (>56.0%).
- With small grids (4 or 5 mm), to help providing structure.
- With “fleshy” fruit (high pulp/pit ratio).
- With low extraction efficiencies (< 85.0%).
- Others (Low pumping capacity <60.0% of decanter capacity).
- Start with 1.0% and adjust according to oil content in pomace and pumping capacity.

BOUNDARY BEND LIMITED

Common Salt (NaCl)

- High solubility in water. It does not make the oil “salty”
- Action: It changes the density of the water stretching out the gap of water:oil densities
- Greener oils as it increases chlorophyll solubility
- Dose = 1-3%
- Significantly cheaper than talc & microtalc powder

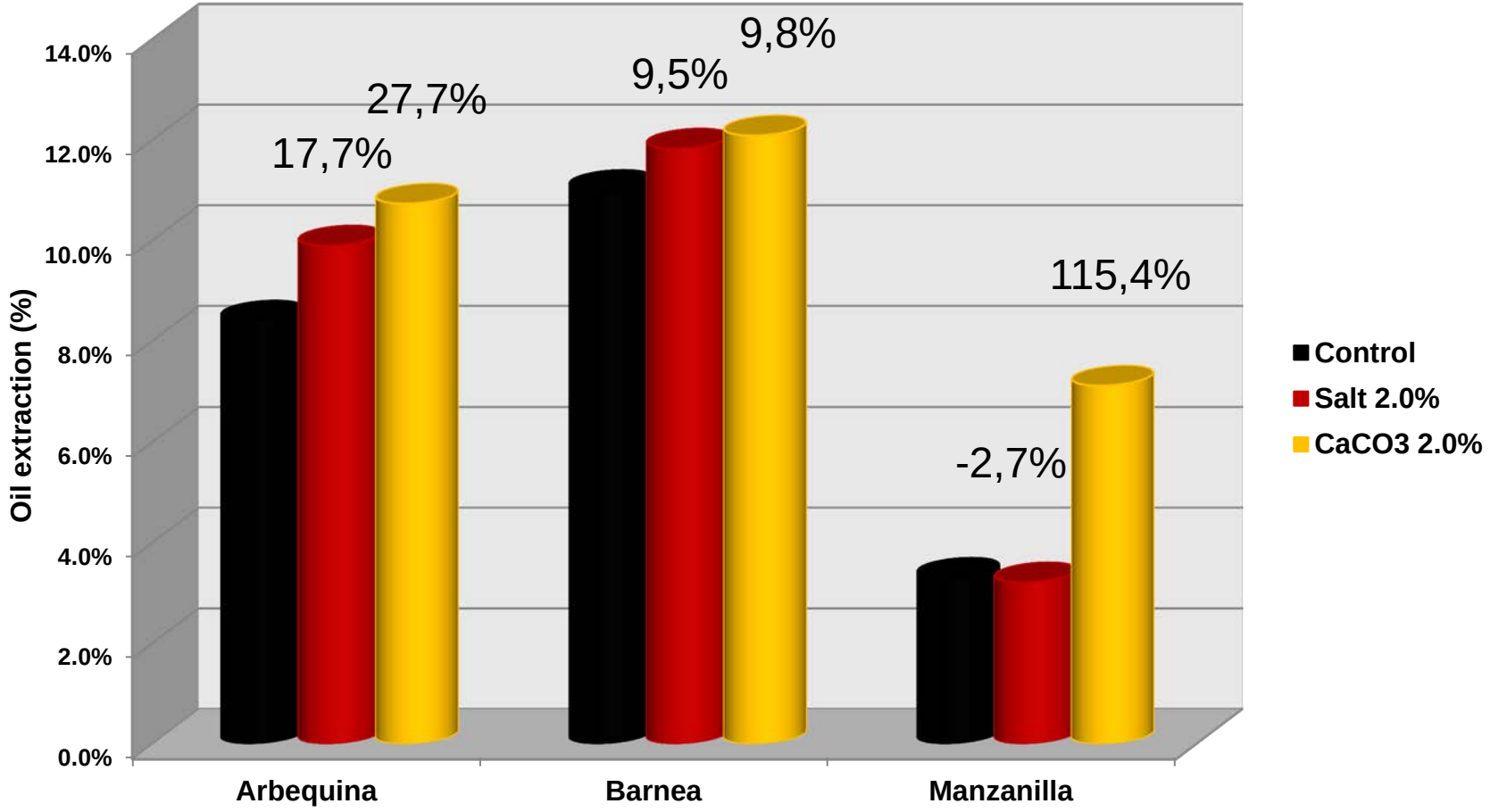
BOUNDARY BEND LIMITED

Calcium carbonate

- Natural mineral with crystalline structure (calcite)
- Hydrophillic affinity
- It facilitates flocks agglomeration by adsorption (similar action to Talc powder)
- d50% = 2.8µm
- Density = 2.7 gr/ml
- Dose = 1-2%
- Cheaper than Talc powder
- Used in Spain with excellent extraction efficiency results

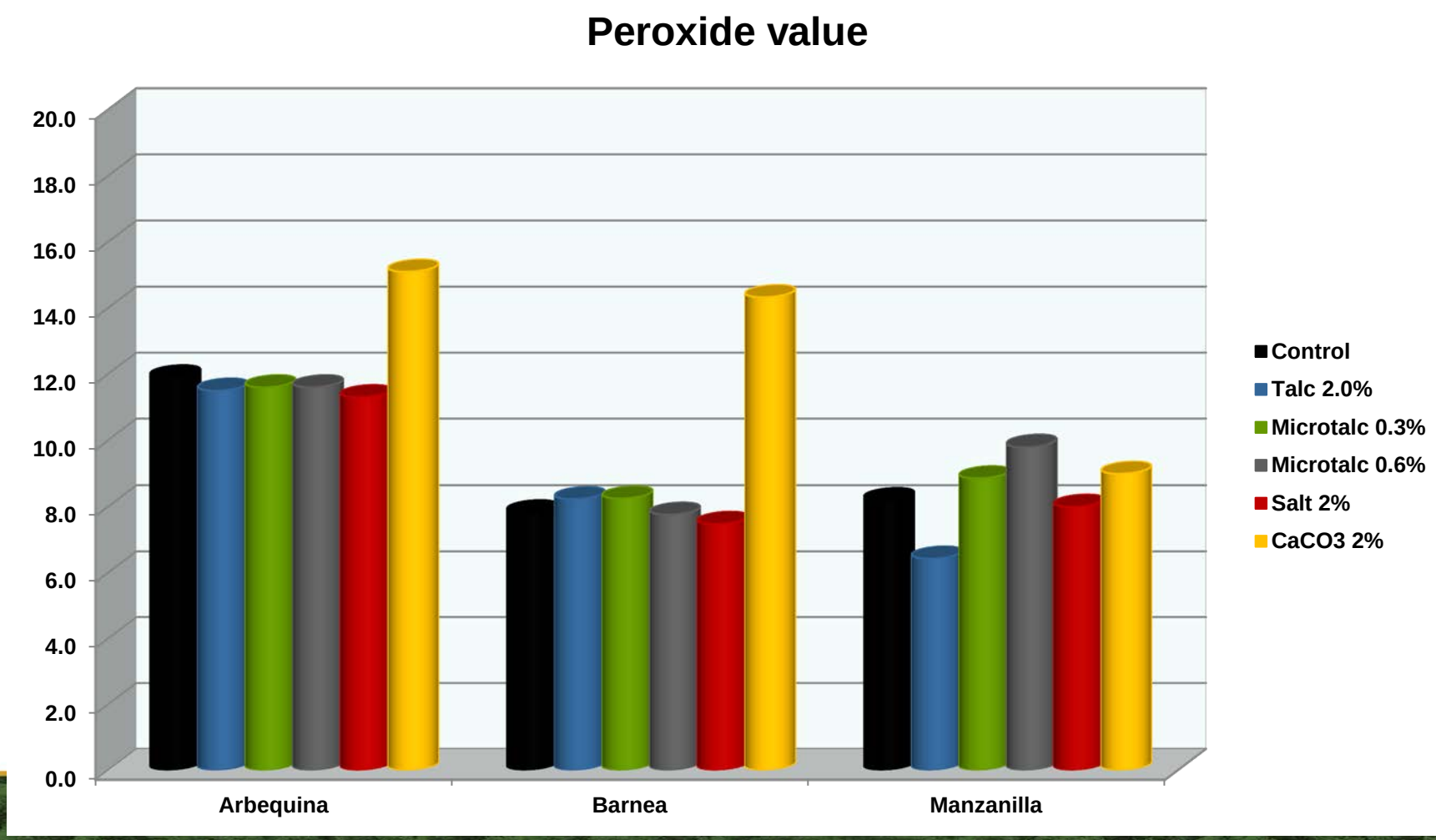
BOUNDARY BEND LIMITED

Salt & Calcium carbonate



BOUNDARY BEND LIMITED

Solid aids



BOUNDARY BEND LIMITED

Solid aids

Pomace

	pH	Conductivity (µS)
Control	5.07	17750
Salt	5.02	46040
Calcium carbonate	5.53	23140

BOUNDARY BEND LIMITED

Salt & Calcium carbonate

Salt (NaCl)

- Improves extractability
- No impact on taste
- Slightly greener oils
- Higher PPH content in oil and slightly higher stability
- Increases CE of pomace

Calcium carbonate

- Aggressive on paste
- Very high extractability
- Reduces FFA
- Increases pH of pomace
- Oxidative action (PV, UV)
- ↓↓ PPH, stability & bitterness
- Very green oils
- Changes in taste

BOUNDARY BEND LIMITED

Enzymes

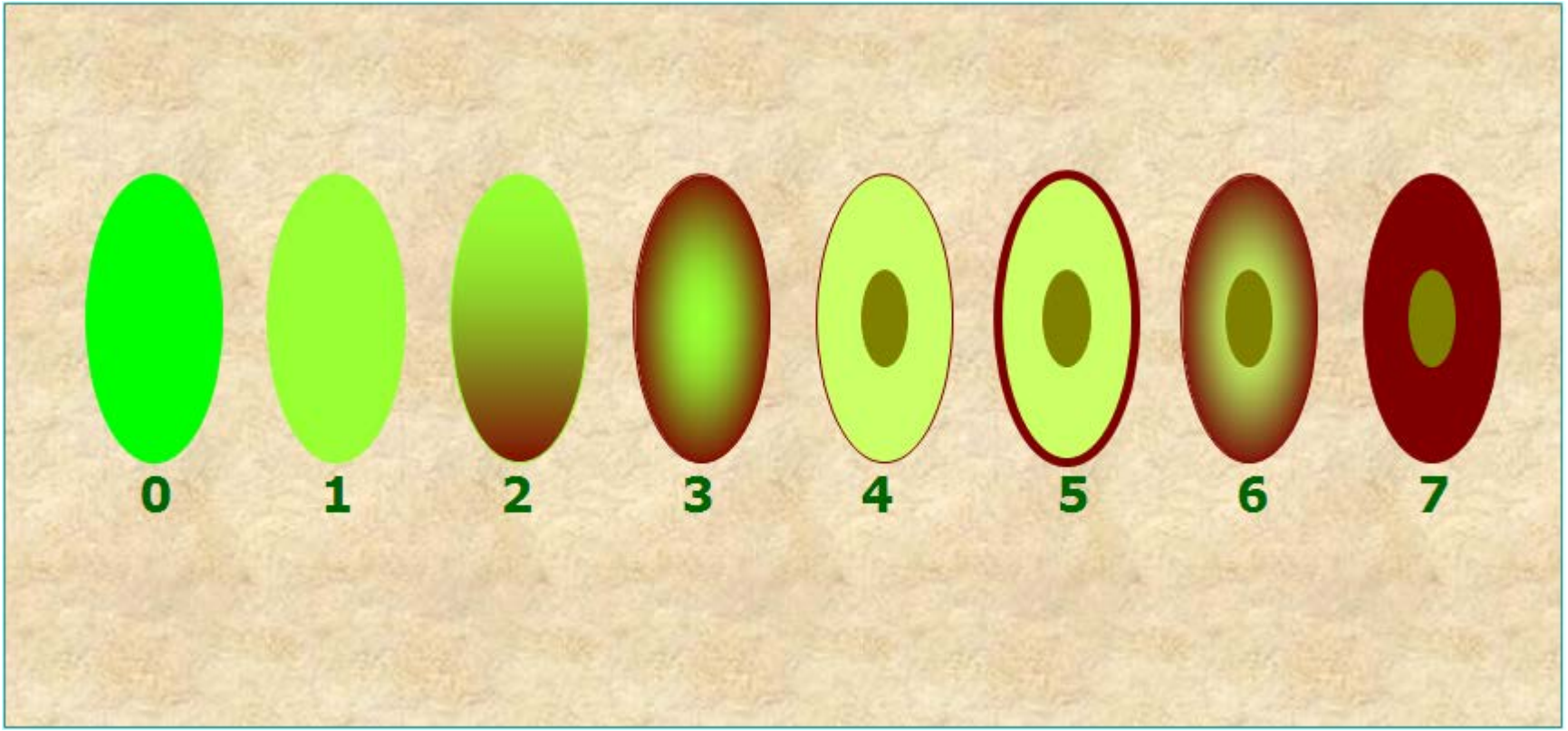
- Very effective in improving the paste extractability
- Biologically active protein substances that help in degrading the pectin & cellulose of the cell walls & vacuoles
- They are produced from Aspergillus aculeatus or niger
- Same enzymes that the fruit has in its tissues
- Endogenous enzyme system depends on the season, variety & maturity and is inactivated by polyphenols
- Dose = Variable (200-500ml/tn). Higher in dry years
- Water soluble and easily removed by centrifugation
- Absolutely essential when dealing with low maturity fruit

BOUNDARY BEND LIMITED

Equipment

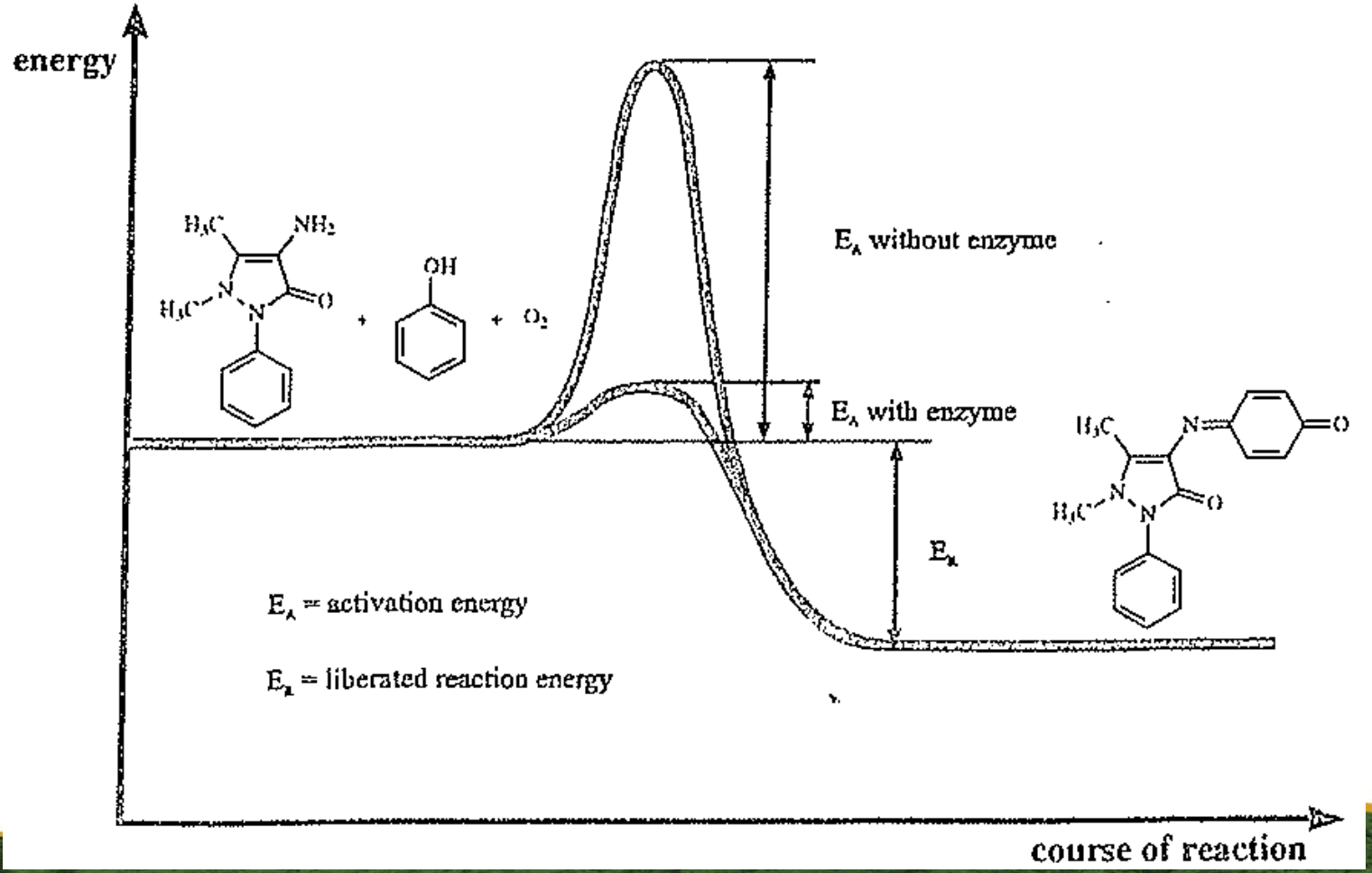
BOUNDARY BEND LIMITED

Enzymes



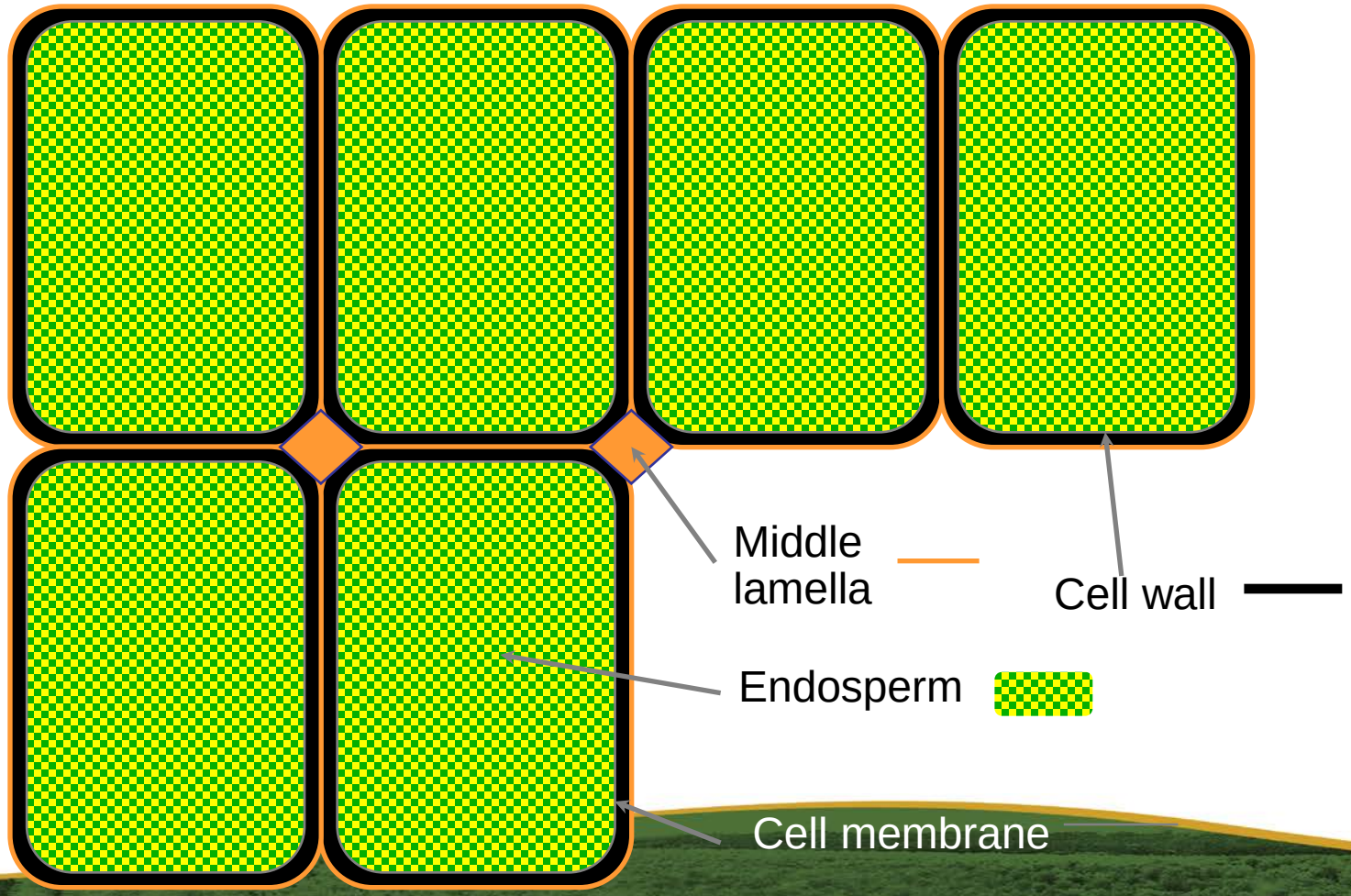
BOUNDARY BEND LIMITED

Enzymes



BOUNDARY BEND LIMITED

Enzymes

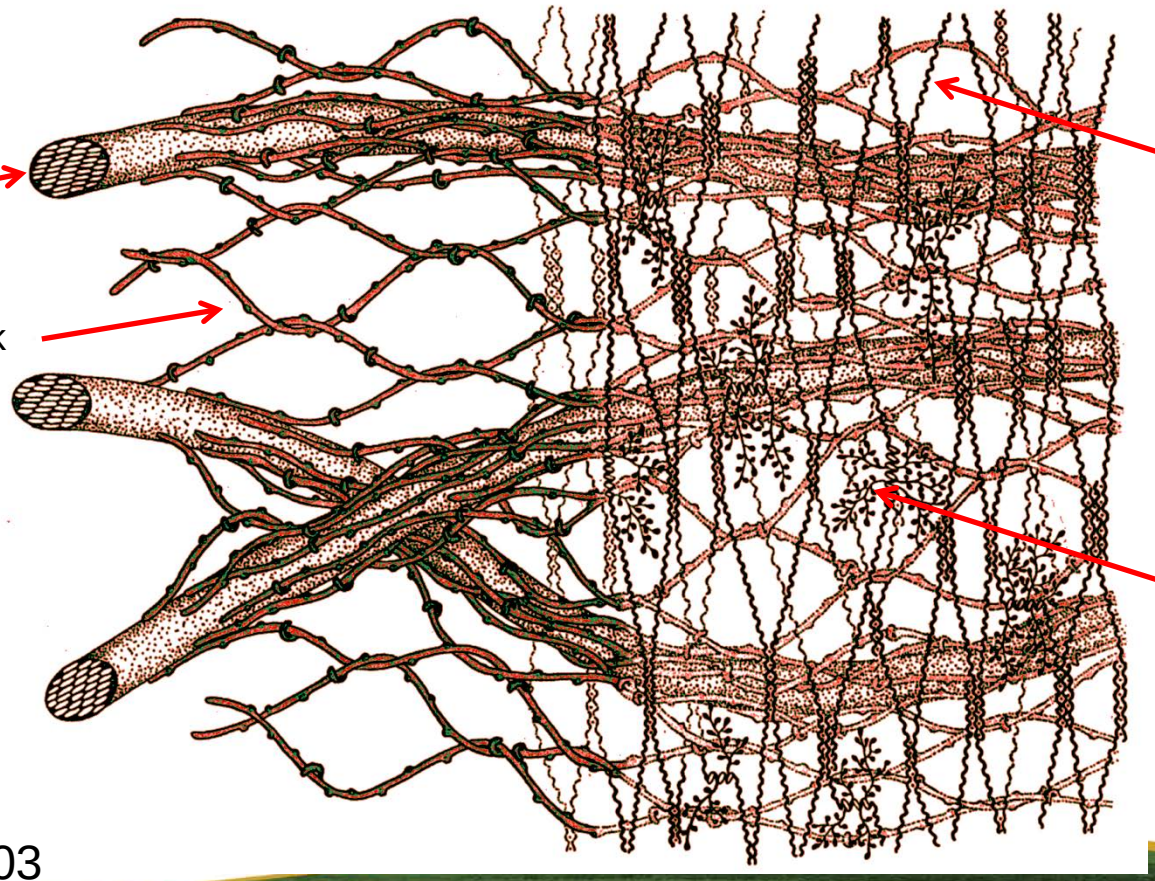


Source: Gunter Maier (NOVOZYMES)

BOUNDARY BEND LIMITED

Enzymes

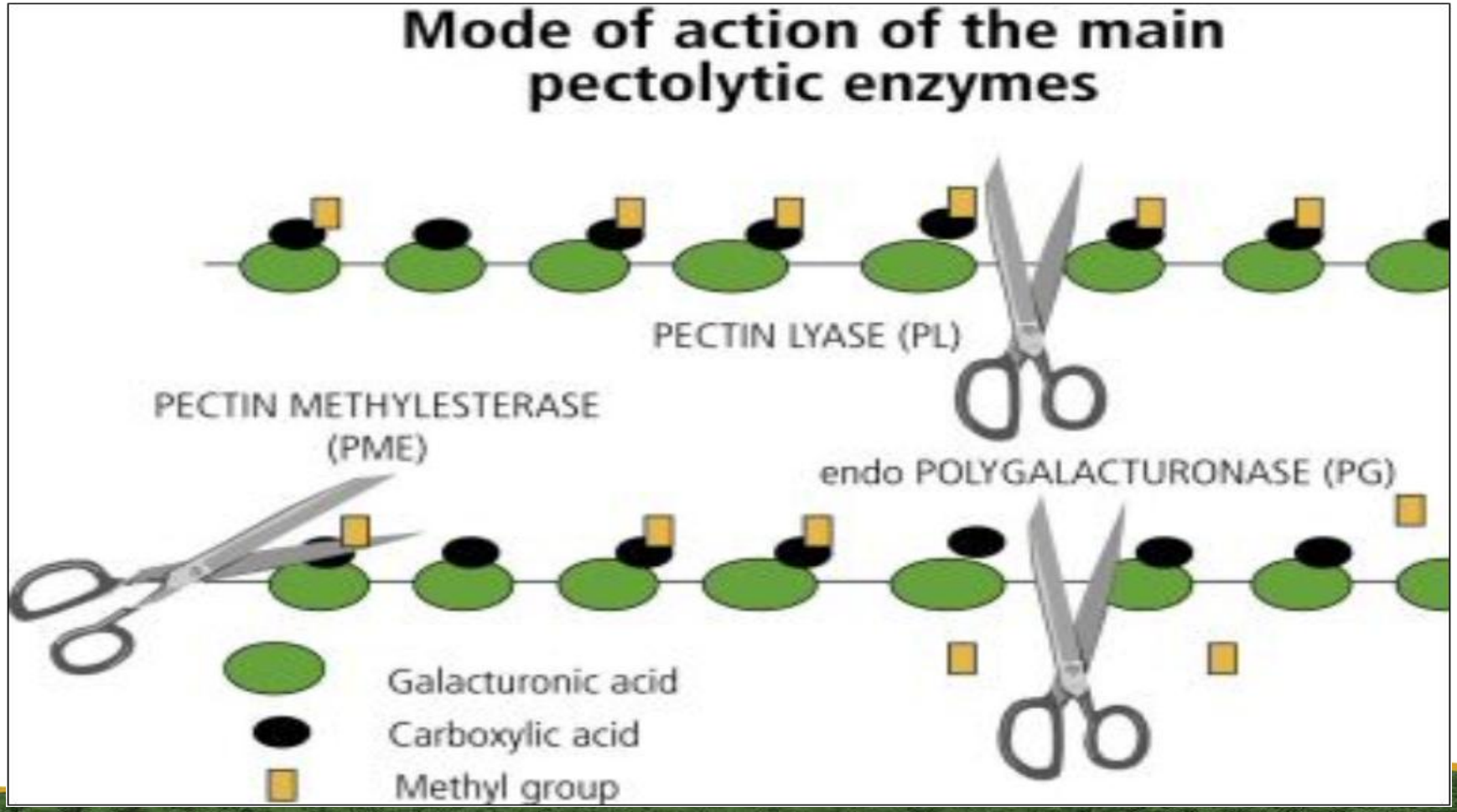
Model of plant cell wall (dicotyledon)



G. Maier, 2003

BOUNDARY BEND LIMITED

Enzymes



BOUNDARY BEND LIMITED

Enzymes

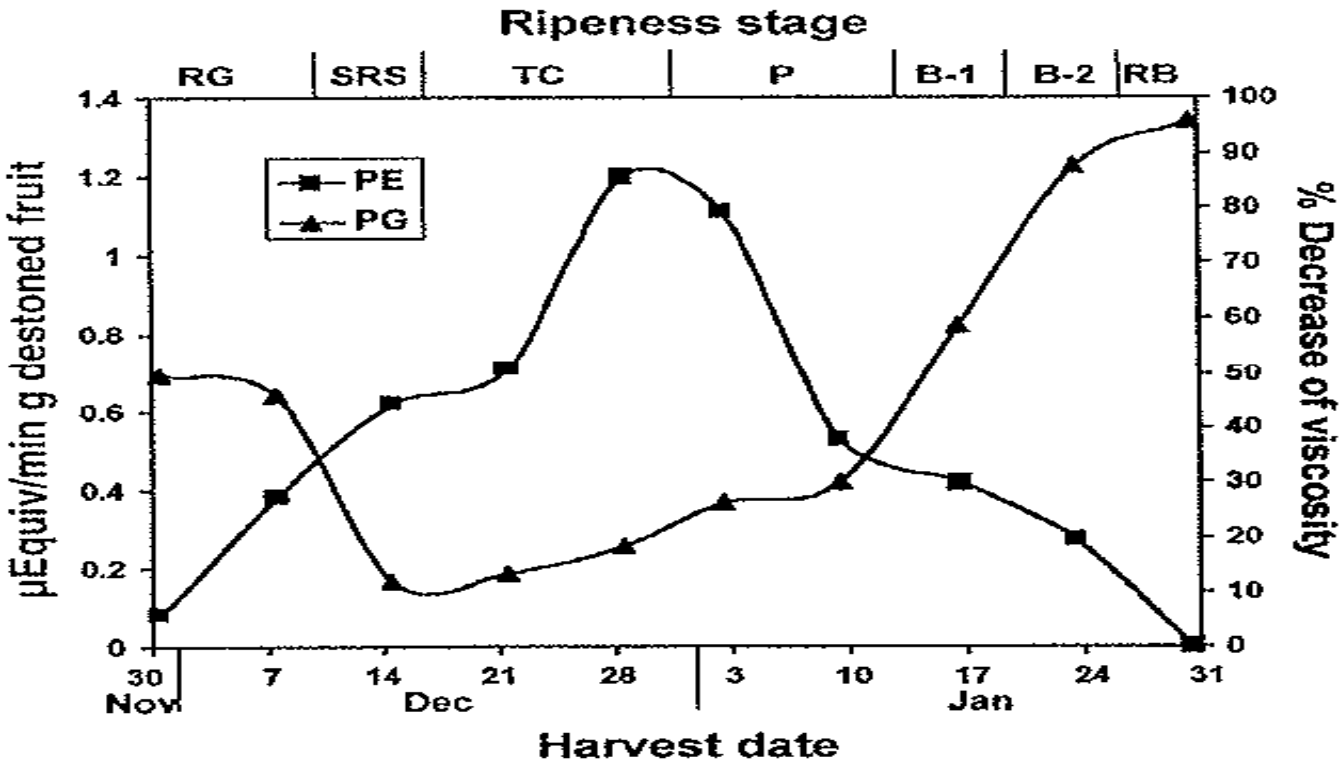


FIG. 1. Changes in PE and PG activity in fruits during ripening of olives. Abbreviations: RG, ripe-green; SRS, small reddish spots; TC, turning color; P, purple; B, black; RB, ripe-black; B-1, fruits with black surface and white pulp; B-2, fruits with black surface and purple pulp; µEquiv, microequivalents; PE, pectin esterase; PG, polygalacturonase.

Source: Minguez-Mosquera et al, 1996

BOUNDARY BEND LIMITED

Enzymes

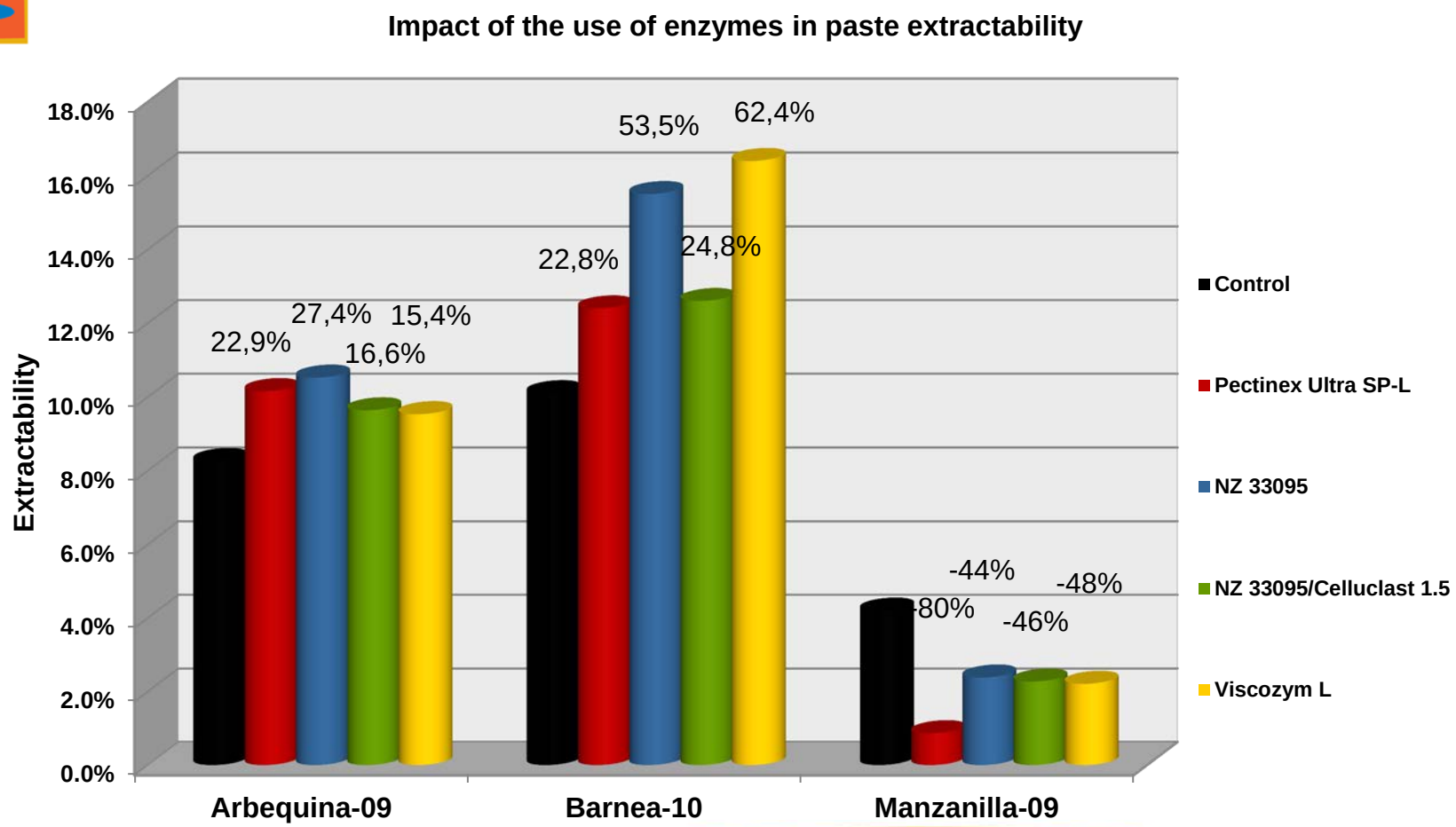
Enzymes trialed:

1. Multi low PG/PL/PE & High side activities (Pectinex Ultra SP-L)
2. High PG/PL/PE & Average side activities (NZ 33095)
3. Average PG/PL/PE & High cellulose activity (NZ33095/Celluclast)
4. Low PG/PL/PE & High betaglucanase side activities (Viscozym-L)

Dose = 0.3%

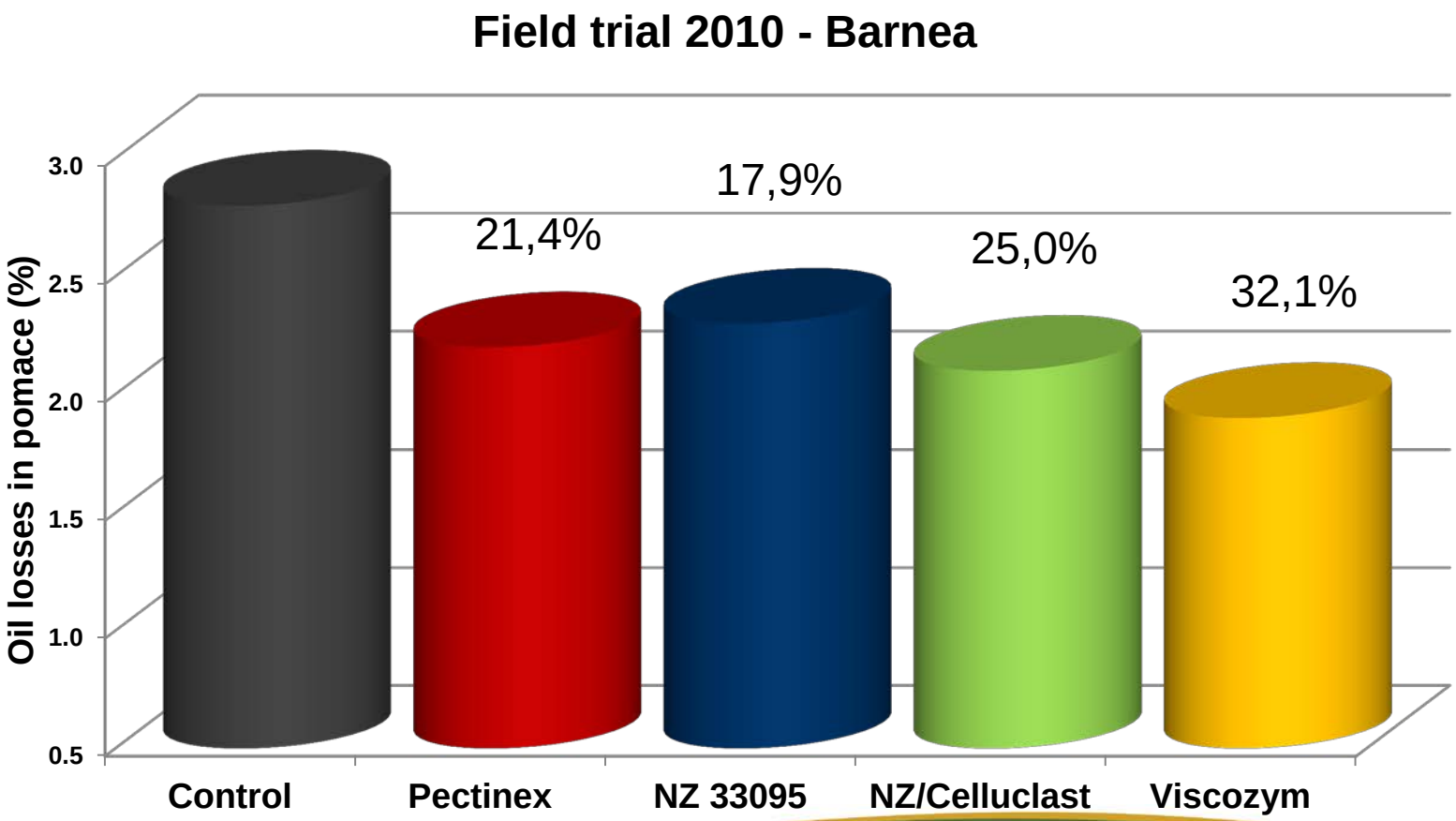
BOUNDARY BEND LIMITED

Enzymes



BOUNDARY BEND LIMITED

Enzymes



BOUNDARY BEND LIMITED

Enzymes

- Very good results in Arbequina & Barnea. It was not a solution for high moisture Manzanilla without talc powder
- No alteration of oil quality for better or worse
- No changes in taste and colour
- No clear impact on fermentation parameters: FFA, DAG
- No significant impact on oxidative parameters: PV, UV, PPH & Rancimat
- It seems that the relative content of “smooth” and “hairy” regions in the fruit cell walls each year is different and that determines which composition will be more effective

BOUNDARY BEND LIMITED

Enzymes

When should I use enzymes and how much of it?

- With difficult varieties (Arbequina, Leccino, Picual, Hojiblanca, Manzanillo).
- With green fruit (MI <3.5)
- With large grids (6 or 7 mm).
- With low extraction efficiencies (< 85.0%).
- Others (Low pumping capacity <60.0% of decanter capacity).
- Start with 0.2% and adjust according to oil content in pomace and pumping capacity.

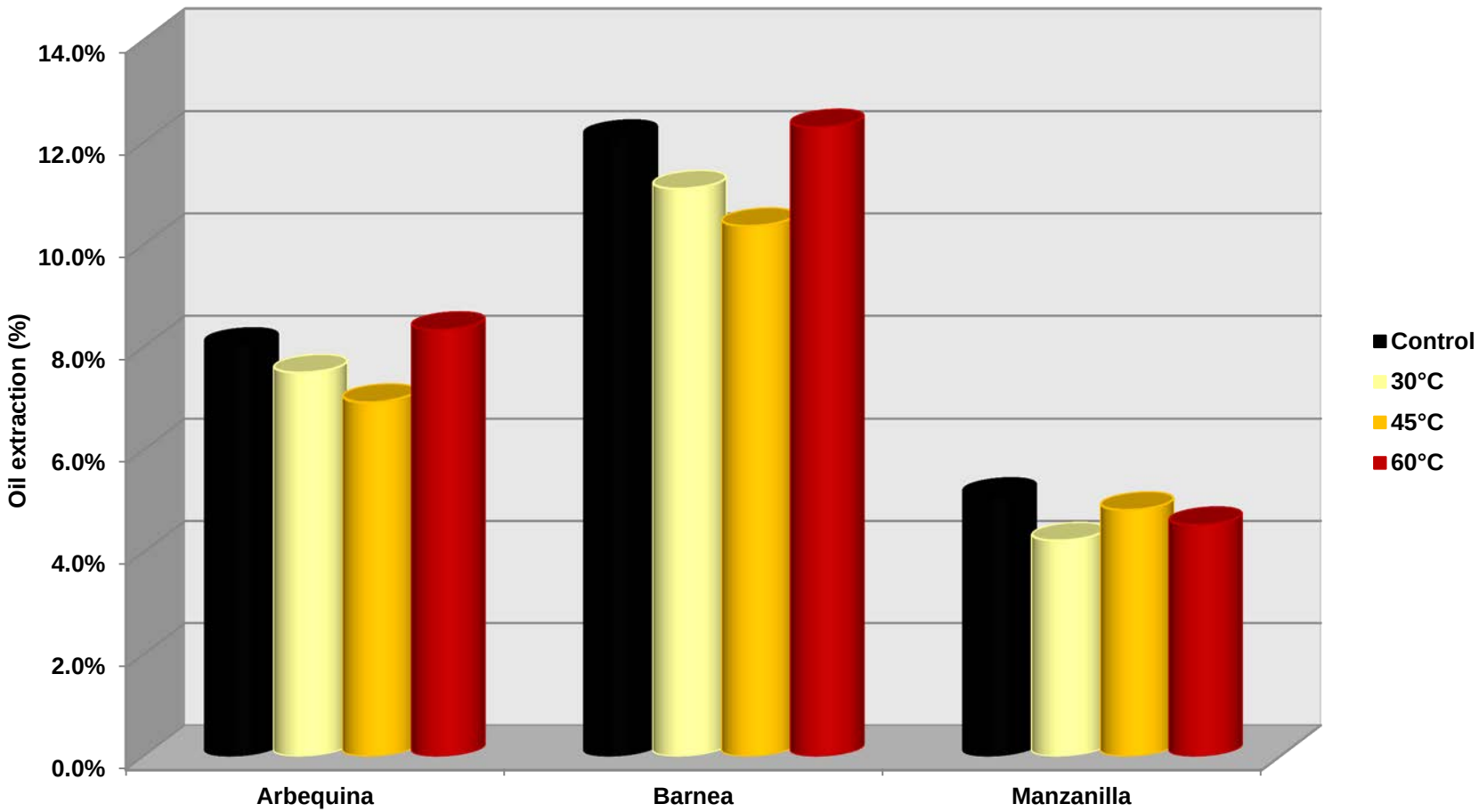
BOUNDARY BEND LIMITED

Warm water dipping

- It consists of pre-heating olives before crushing to achieve a higher temperature at beginning of malaxing
- Technique: Immersion of olives for 3 minutes in warm water at 30-45-60°C
- Research works in Spain indicate that dipping:
  1. Increases paste extractability
  2. Reduces bitterness
  3. Inhibits LOX enzyme → Delays oil oxidation
  4. Increases chlorophyll content → Greener oils
  5. No changes in taste

BOUNDARY BEND LIMITED

Warm water dipping



BOUNDARY BEND LIMITED

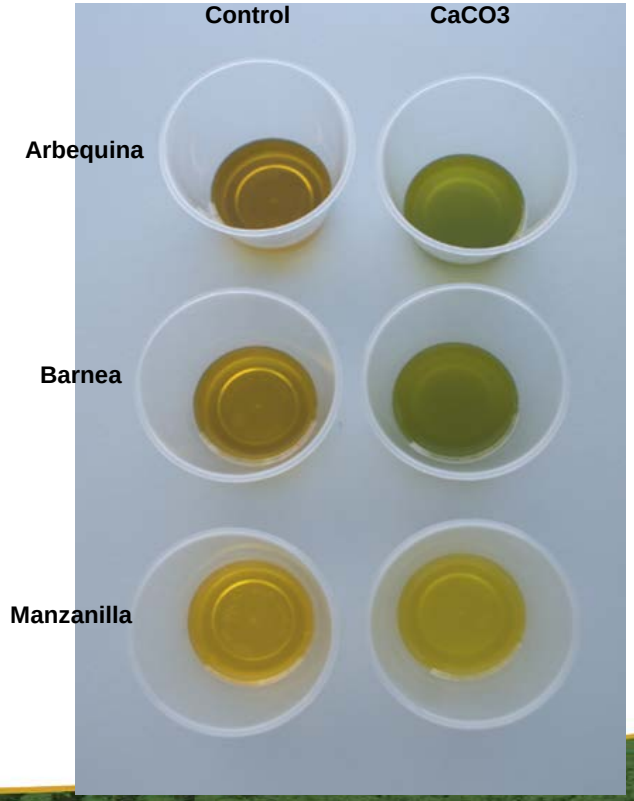
Warm water dipping

- Simpler to implement in small Plants working in “batching” modality. More complicated for larger Plants
- Paste extractability showed slight improvements only at 60°C
- Increase in the moisture content of the fruit, making the extraction process more difficult
- Combined with talc could be interesting
- Oils are greener, but there is a change in taste too
- There is a clear reduction of the bitterness
- There is a reduction of the oxidative stability

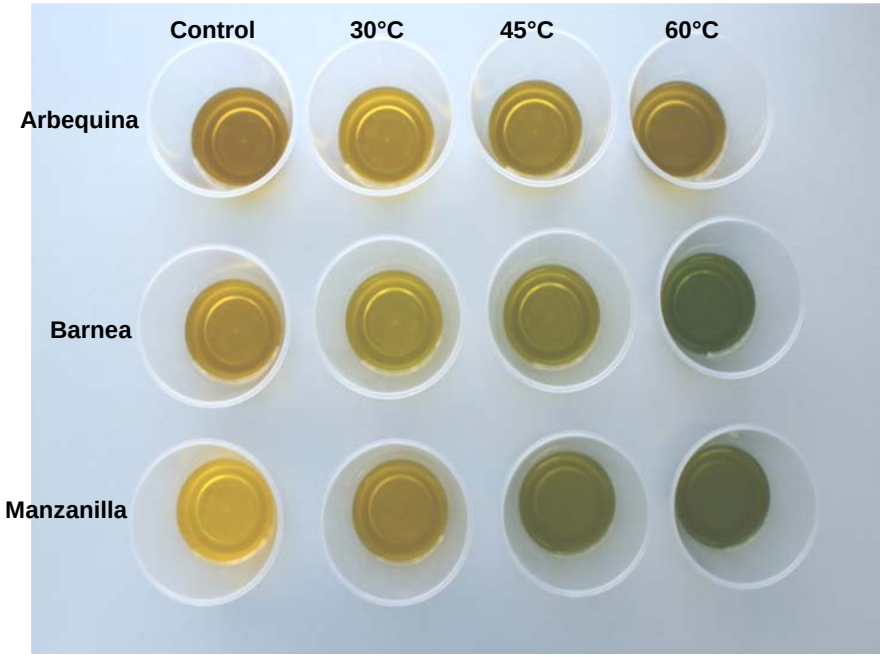
BOUNDARY BEND LIMITED

Warm water dipping

Calcium carbonate

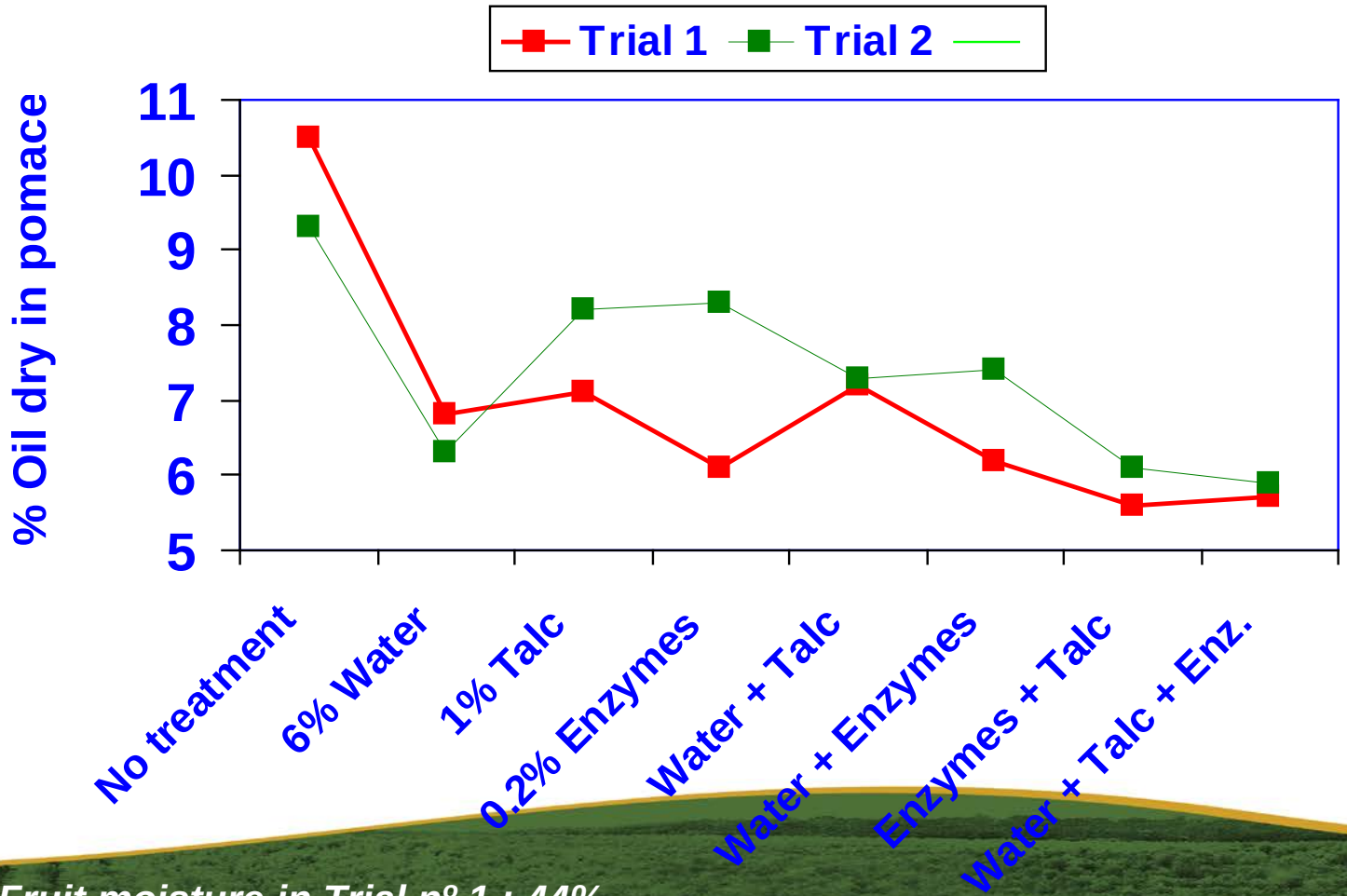


Warm water dipping



BOUNDARY BEND LIMITED

Water of injection



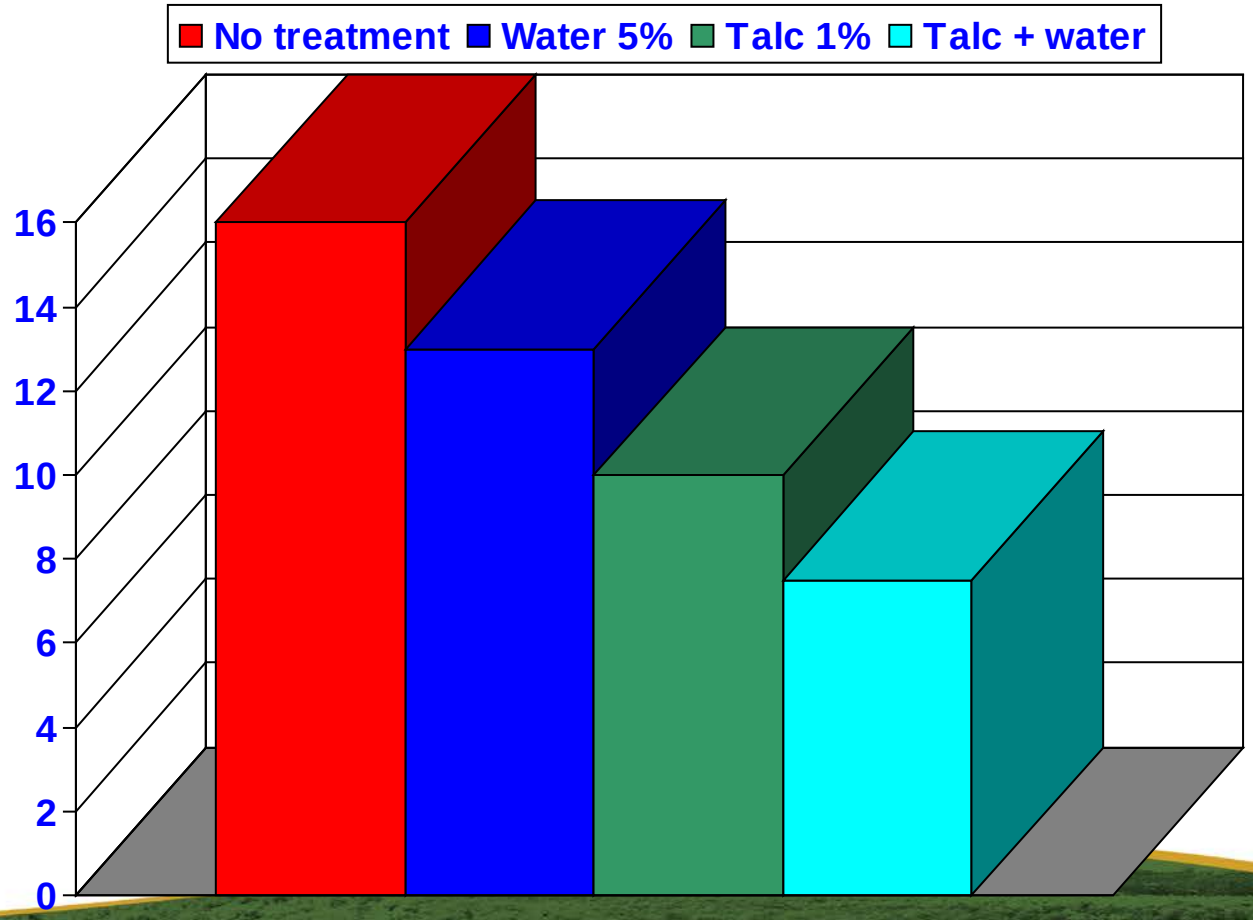
Fruit moisture in Trial nº 1 : 44%

Fruit moisture in Trial nº 2 : 40%

Marino Uceda – Australia 2005

BOUNDARY BEND LIMITED

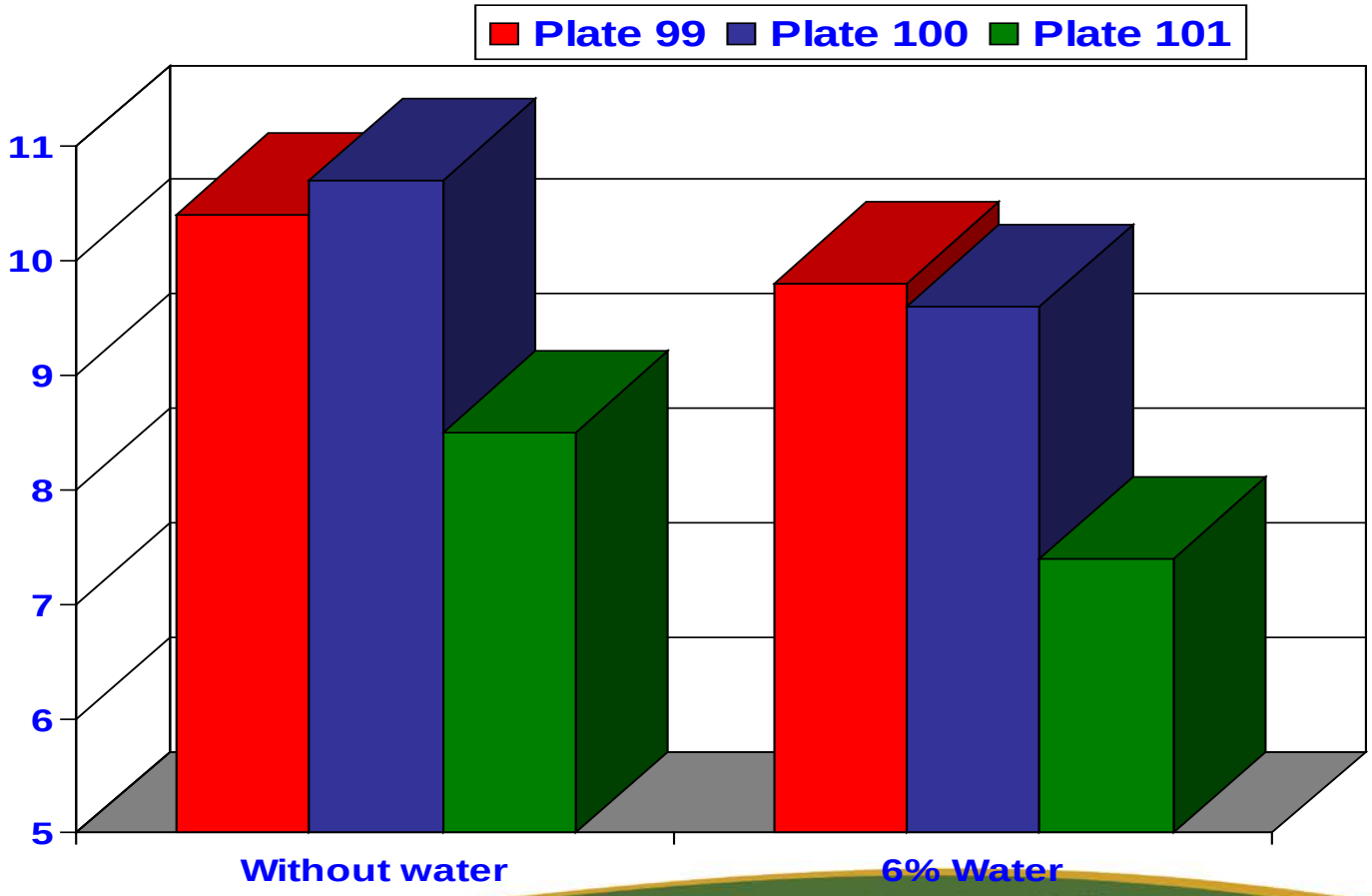
Water of injection



Fruit: 45% moisture

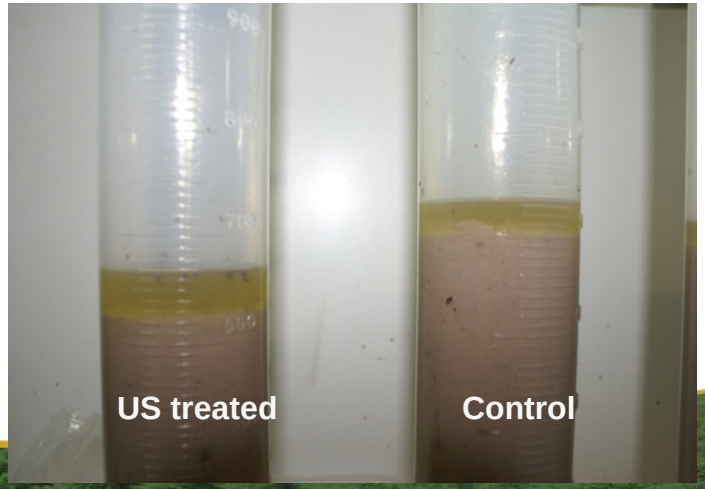
BOUNDARY BEND LIMITED

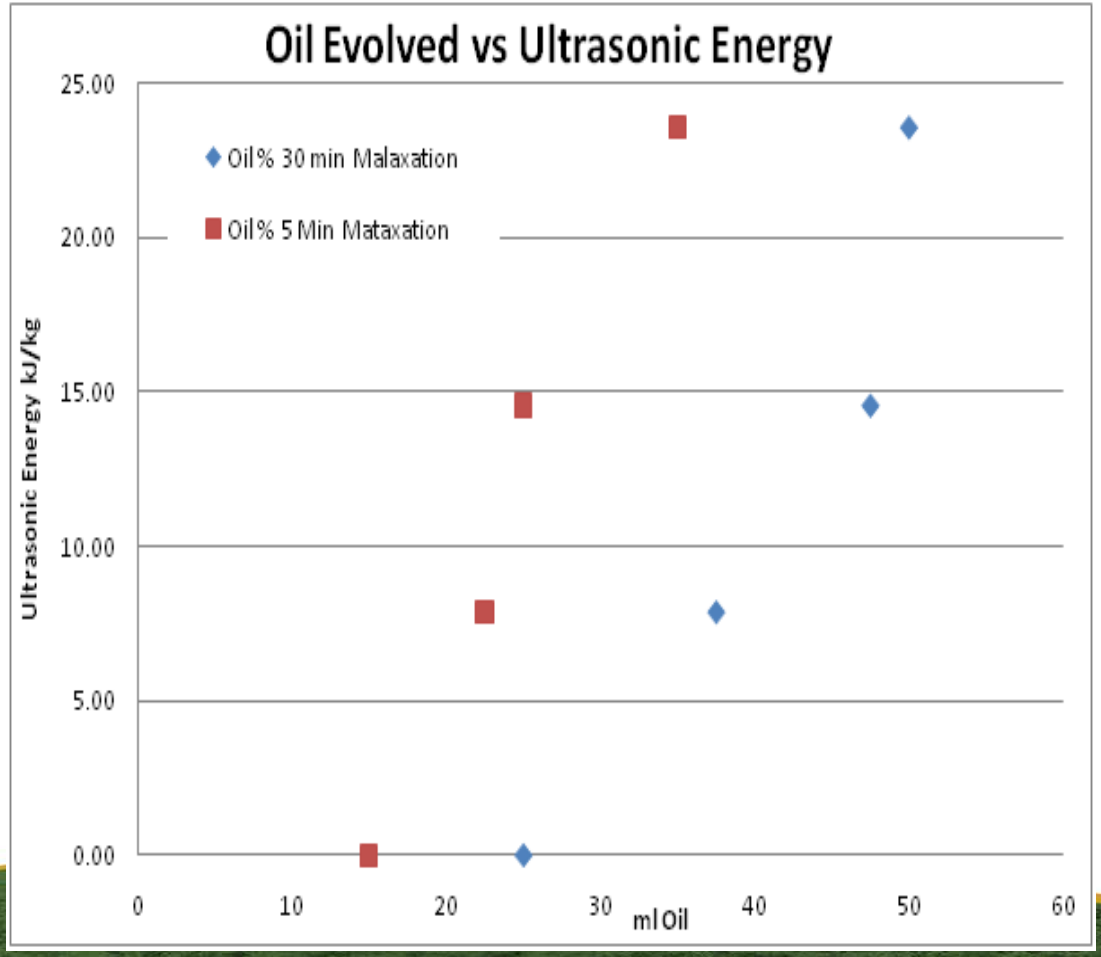
Water of injection



BOUNDARY BEND LIMITED

Ultrasound





BOUNDARY BEND LIMITED

Ultrasound

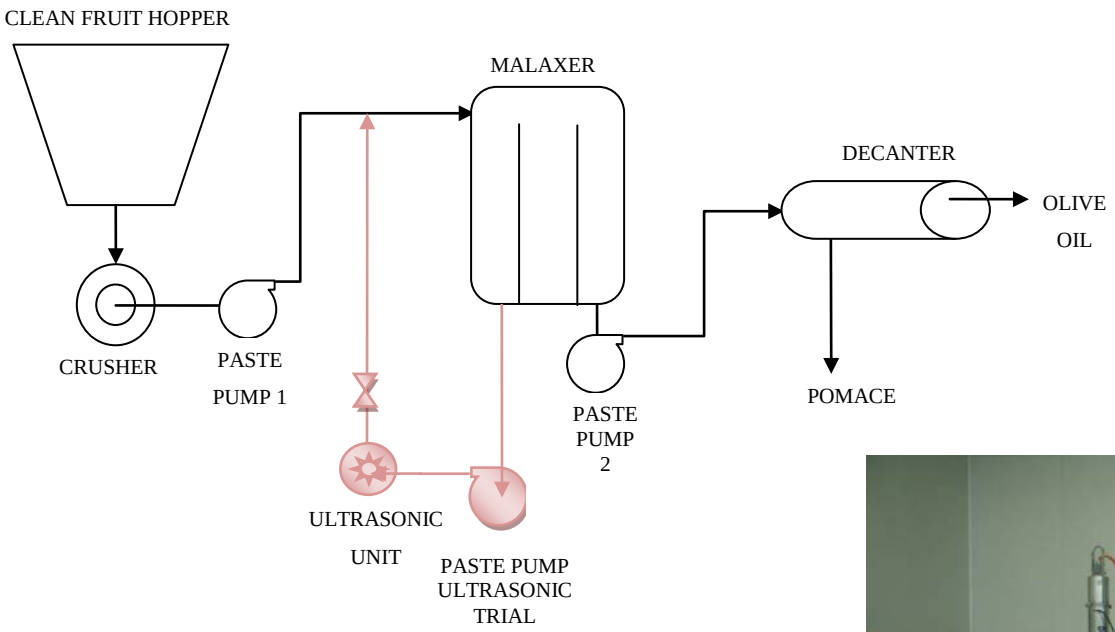
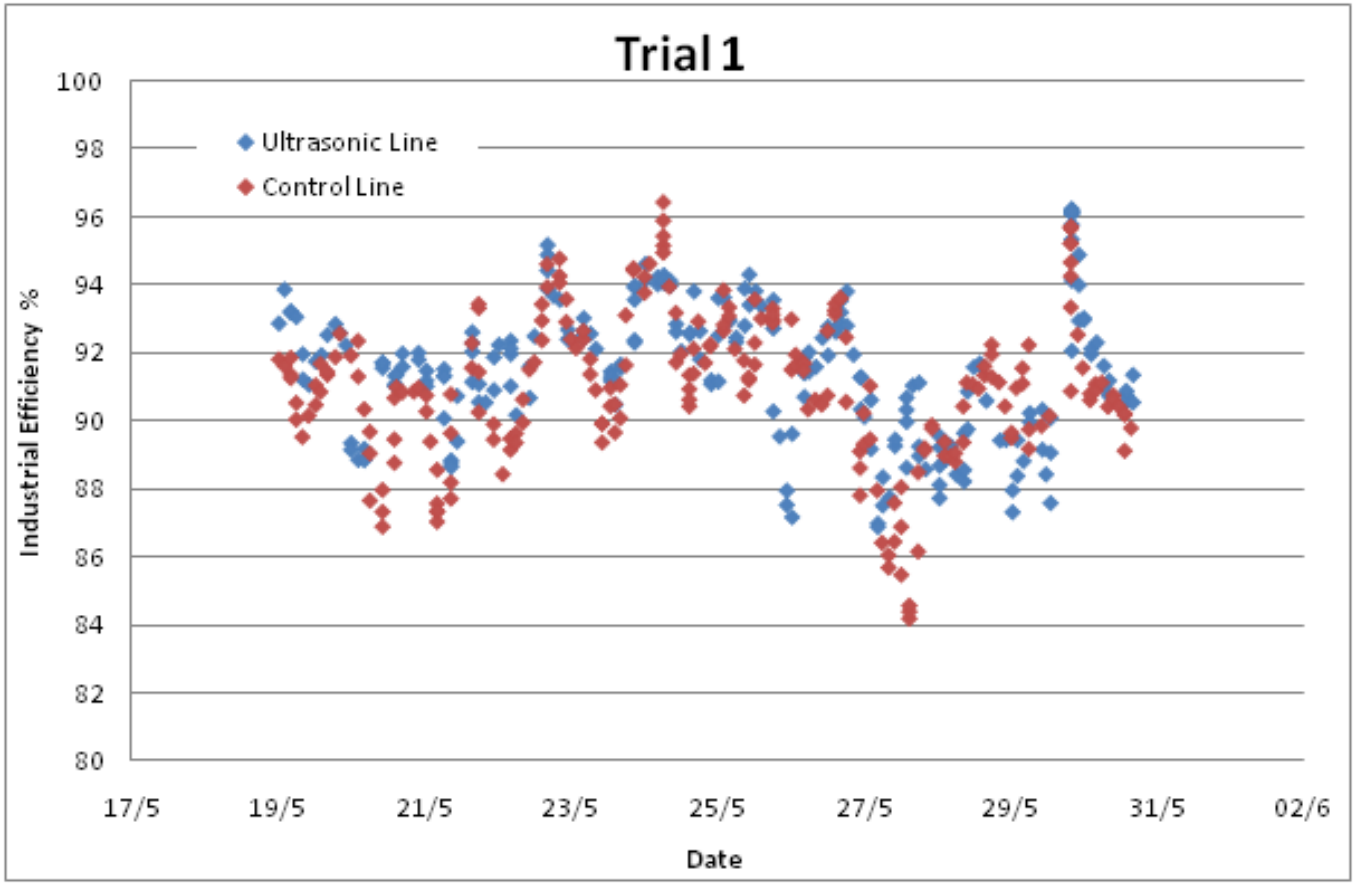


Figure 1: Process Flow Diagram

BOUNDARY BEND LIMITED

Ultrasound



BOUNDARY BEND LIMITED

Ultrasound

- Research in very early stages
- Olive paste is supplied with ultrasound energy in order to break down wall cell and release the oil
- There is a beneficial increase in the paste temperature
- It seems to be more effective on green fruit
- Lab trials showed very good results on paste extractability
- Field trials with variable results. More work to be done here
- No apparent impact on oil quality

BOUNDARY BEND LIMITED

Summary

- **Talc & microtalc powder**: essential with difficult pastes or high moisture fruit. No impact on oil quality
- **Common salt**: Low cost option. No impact on oil quality, though there is a significant increase in conductivity of pomace
- **Calcium carbonate**: another cheap option. High paste extractability. Increases pH of pomace and could impact quality if not properly used
- **Enzymes**: Effective under most conditions. Doses depend on the year and fruit ripeness. No impact on oil quality
- **Warm dipping**: Difficult to implement. Only effective with temperatures above 60°C. It does change the oil quality
- **Ultrasound**: Promising technology. No impact on quality
- **Microtalc powder & enzymes** could be an interesting combination depending on the fruit condition

BOUNDARY BEND LIMITED

Thank you