Characterization of the respiration rate of avocados exported from different countries and its relationship with carbon dioxide

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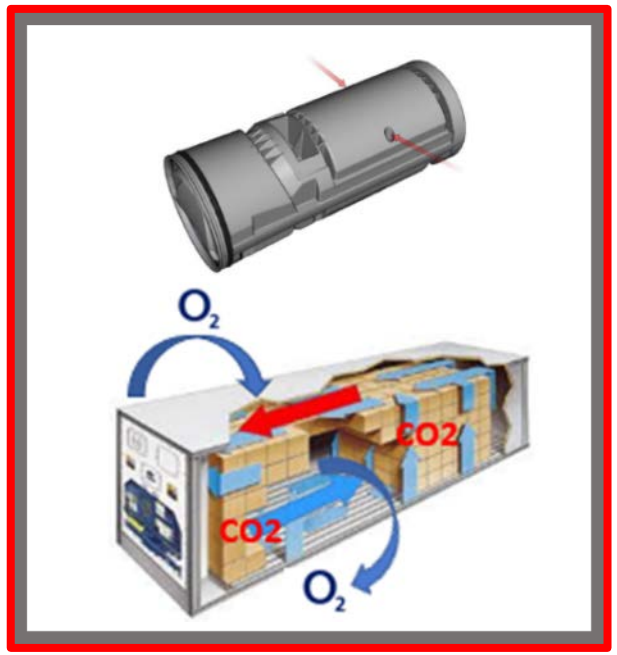
Products y services

Controlled atmosphere



Controlled atmosphere for containers during maritime transit

"Alma" Plataform

Shipment tracking platform

LIVENTUS FULL CONTROL

Bag technology to control weight loss and dehydration. **Controlled atmosphere compatible**

Post Harvest Consulting

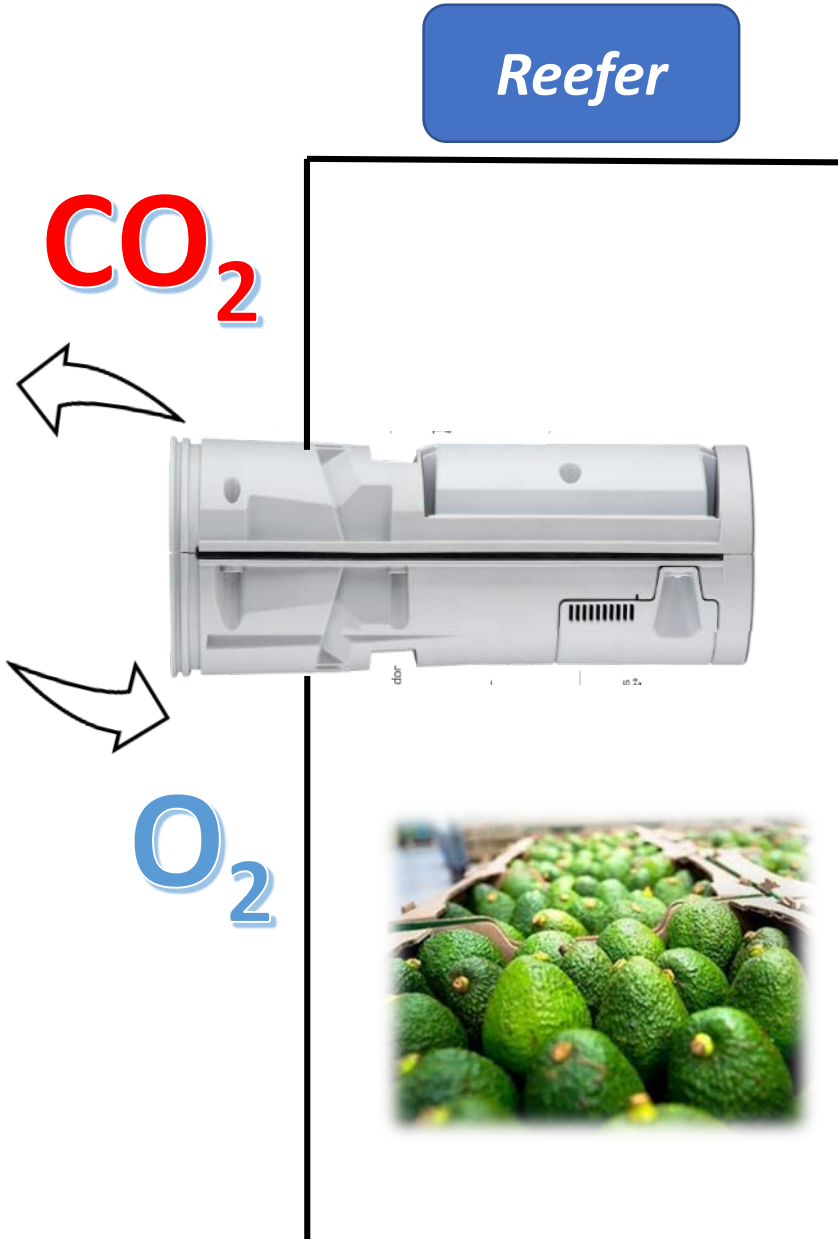
Identification and solution of problems along the post-harvest chain

How works our technology?

- Valve opening in the controller. We can maintain a certain set point due to the natural respiratory rate of avocados.

- We measure gas concentration, valve openings, and return temperature throughout the entire transit in all of our services.

What we can do with this information?...

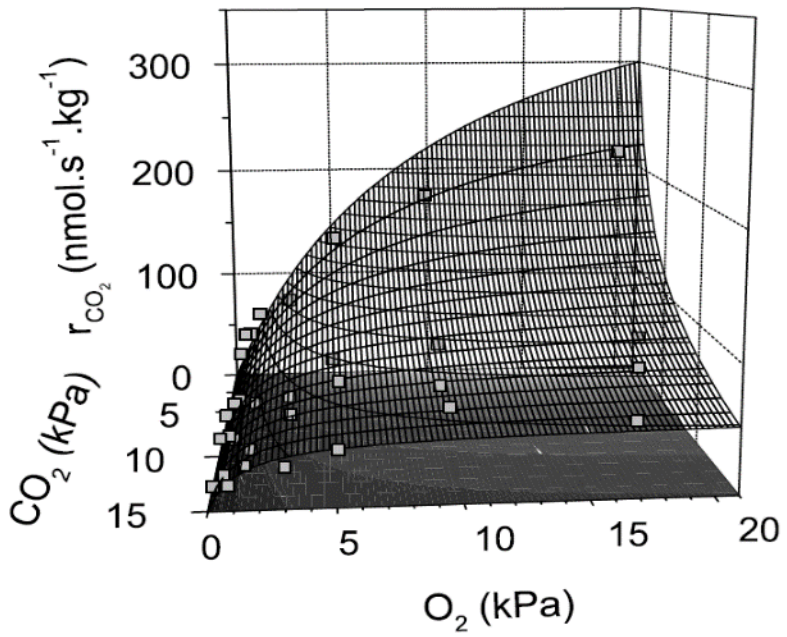


Development of a regression model to establish respiratory rate (RT)

- *Valve opening as KPI to determine respiratory rate*

$$\textbf{Valve opening}\ \left(\frac{\textbf{Valve opening}}{h}\right) \longrightarrow \textbf{Respiration rate}\ \left(\frac{\textbf{ml CO2}}{\textbf{kg h}}\right)$$

R^2 : 0.99
F critical value : 0.0108



(Hertog et al., 2003)

Assumptions:

- Free volume in the container
- Kg of fruit per container

Limitations:

- Liventus Setpoint
- Only consider the variables measured by the controller

Research methodology

2500 services considered for the study

- Universe of data from 2019-2022 from our commercial shipping database from Chile, Mexico, Colombia, Perú and South Africa.

Objectives:

1. Determine differences in respiratory rate among different countries.
2. Verify the effect of CO_2 as a regulator of respiratory rate.

A general and mixed linear model analysis was performed. Comparisons with LSD-Fisher's test with a significance level of 5%.

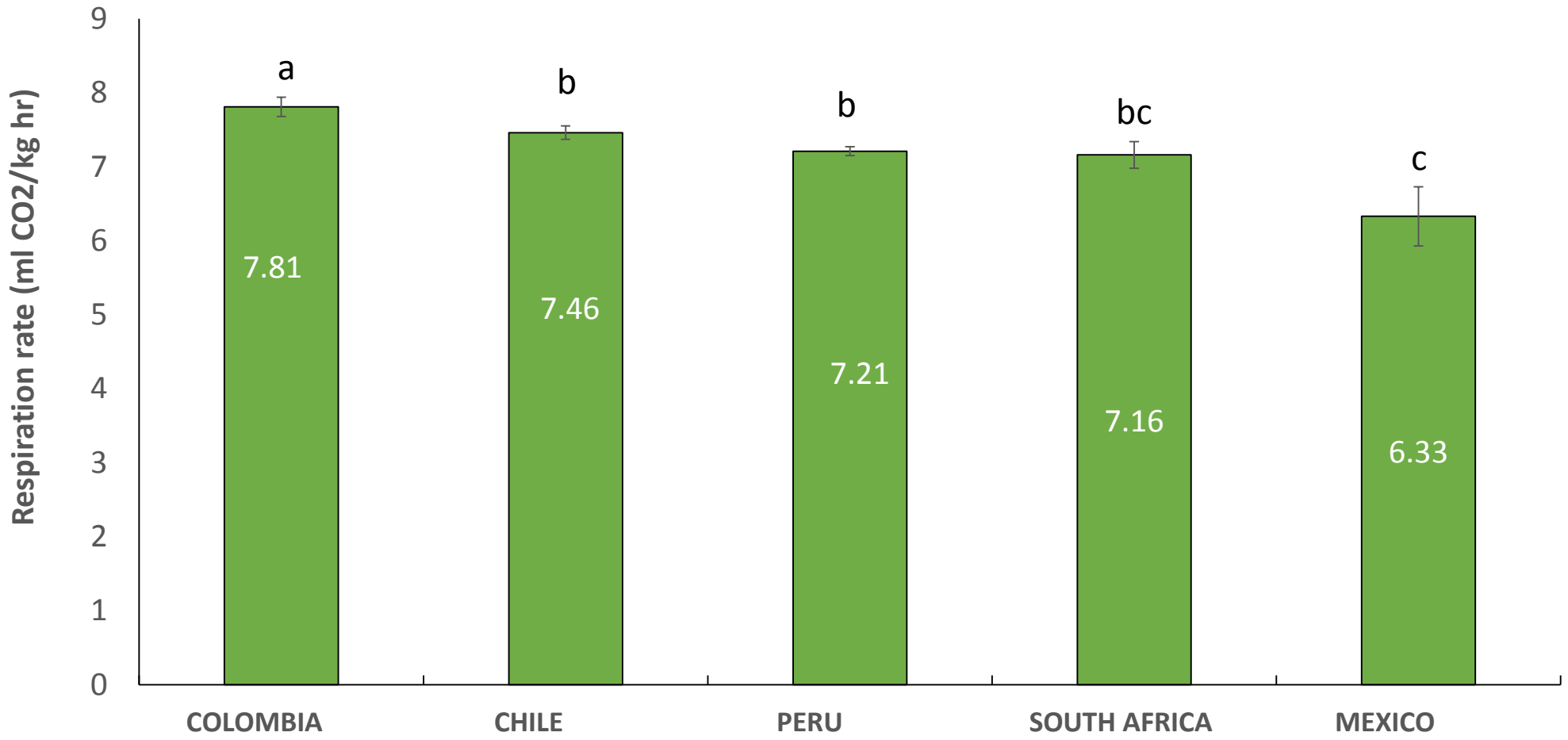
Multivariate analysis:

- Cluster analysis
- Principal Component Analysis (PCA)

Model scopes:
Respiratory rate between 3 to 13 ml CO_2/kg h

Results

Differences between countries

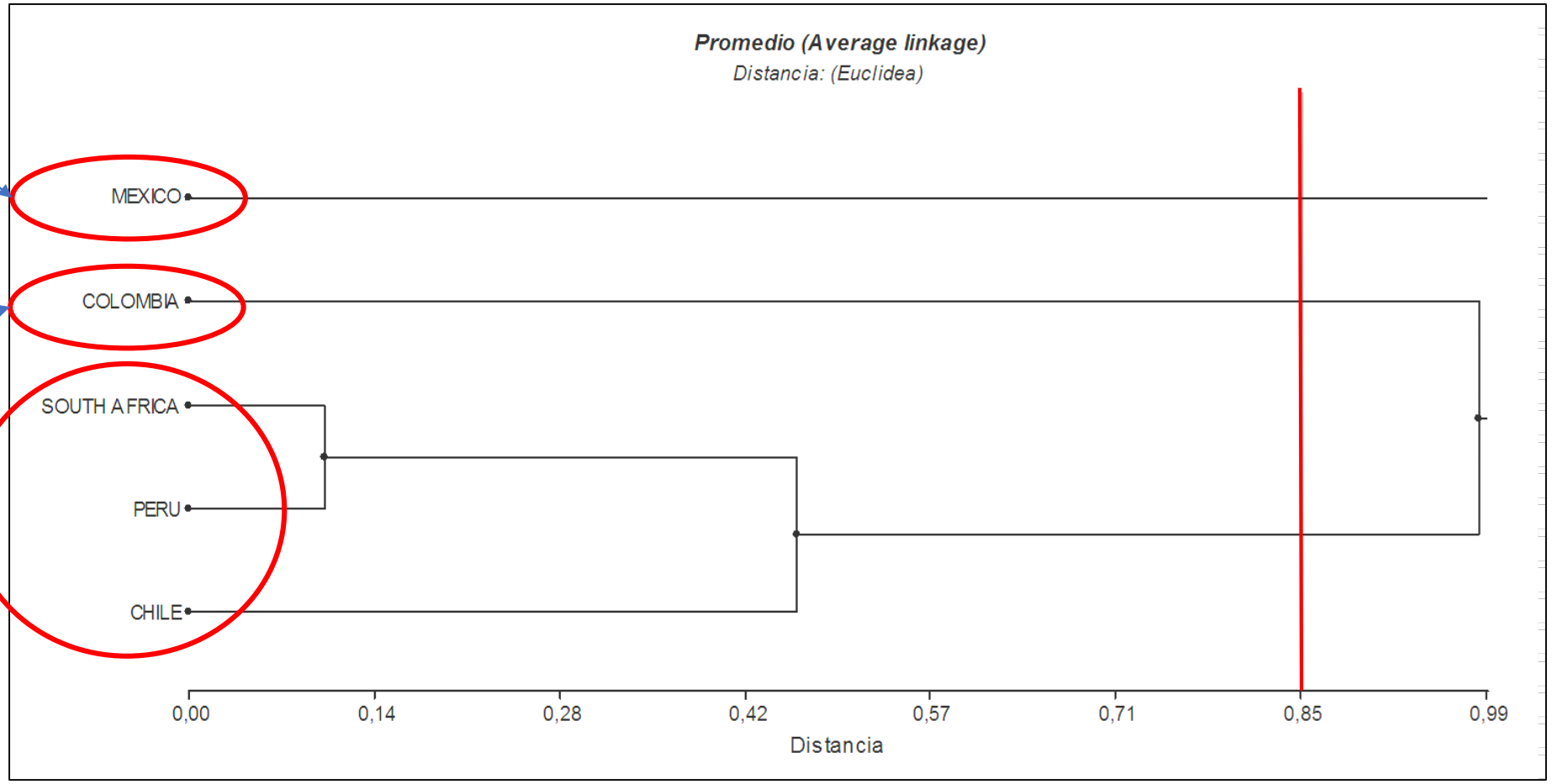


Cluster analysis

Country with a low respiratory metabolism: **Mexico**

Country with a high respiratory metabolism: **Colombia**

Country with a medium repiratory metabolism: **Chile; Perú and South Africa**



How can we regulate the respiratory rate?

To arrive with green and firm fruit…

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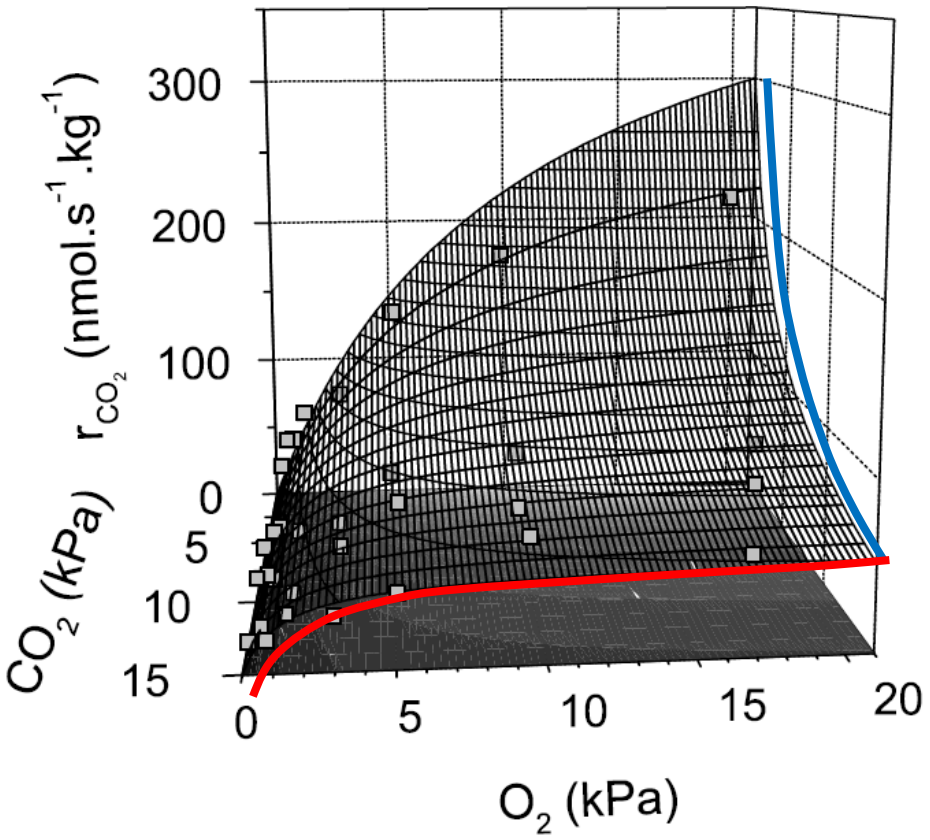
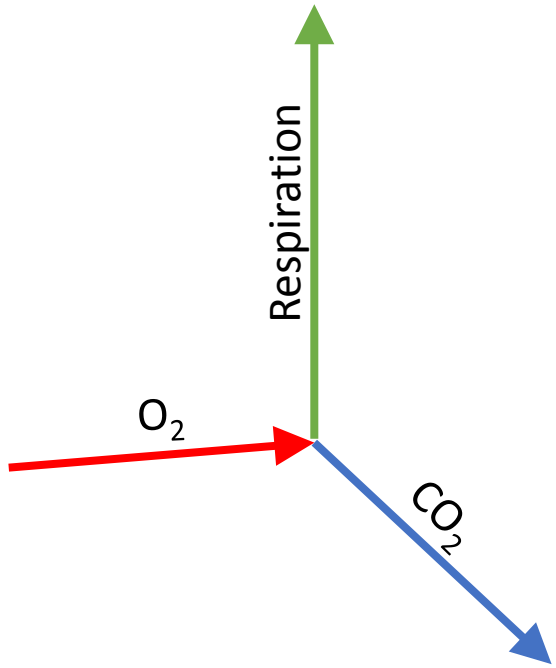
Carbon dioxide effect on respiration rate





Regular air

O2 (%)	CO2 (%)	ml CO2/kg*h
21	0	36,90

Other technologies

O2 (%)	CO2 (%)	ml CO2/kg*h
5	5	7,28
4	6	6,06

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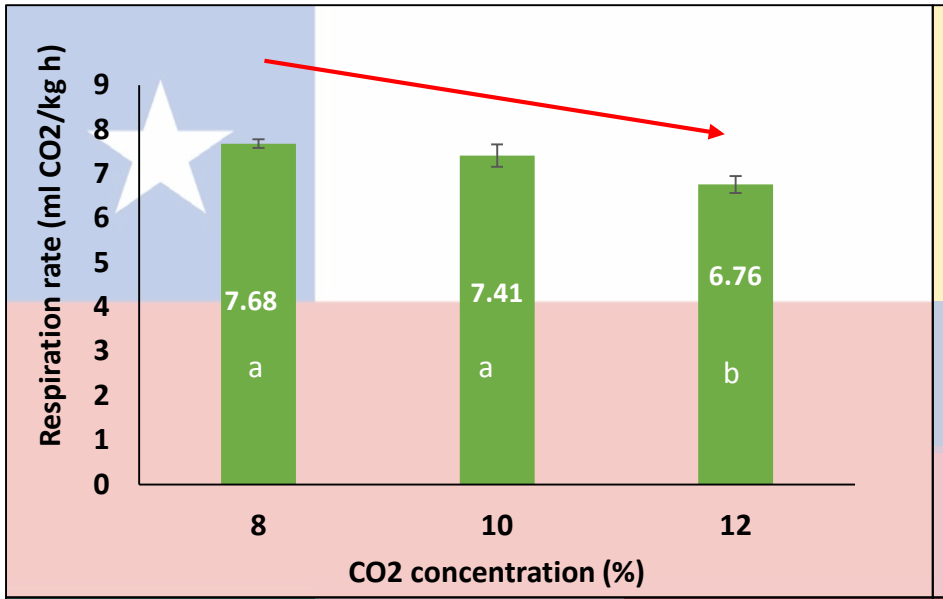
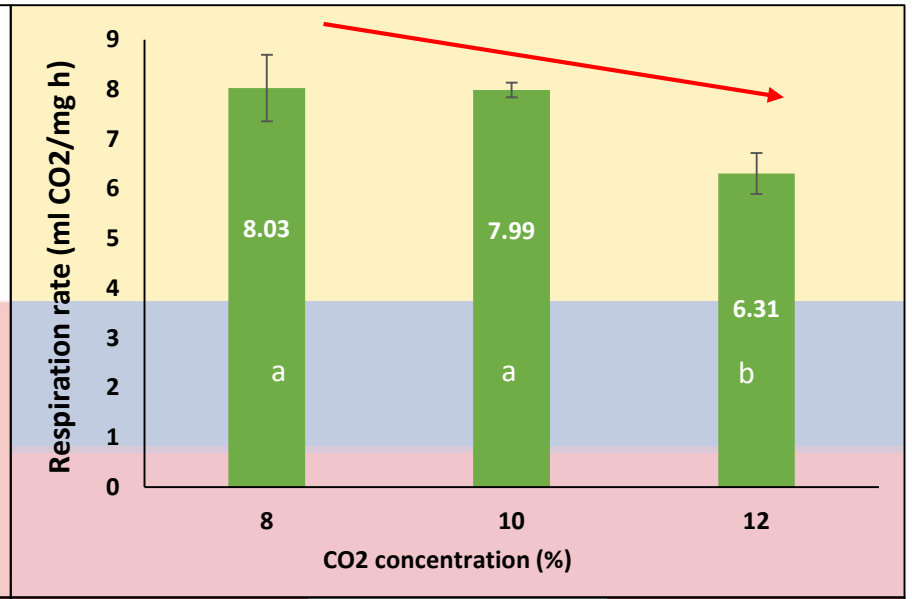
O2 (%)	CO2 (%)	ml CO2/kg*h
12	8	6,92
12	10	5,83
9	12	4,85

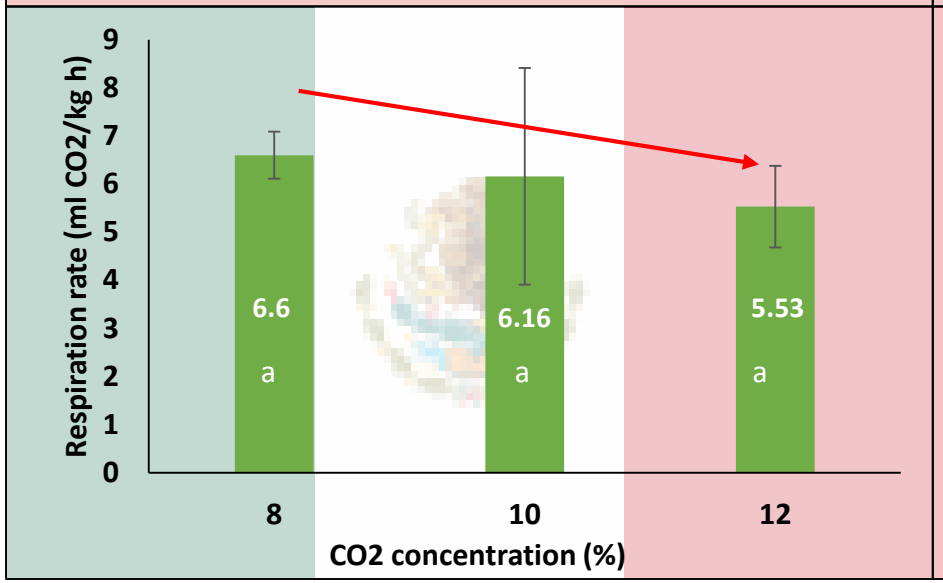
The effect of modified atmospheres on the rate of quality change in ‘Hass’ avocado

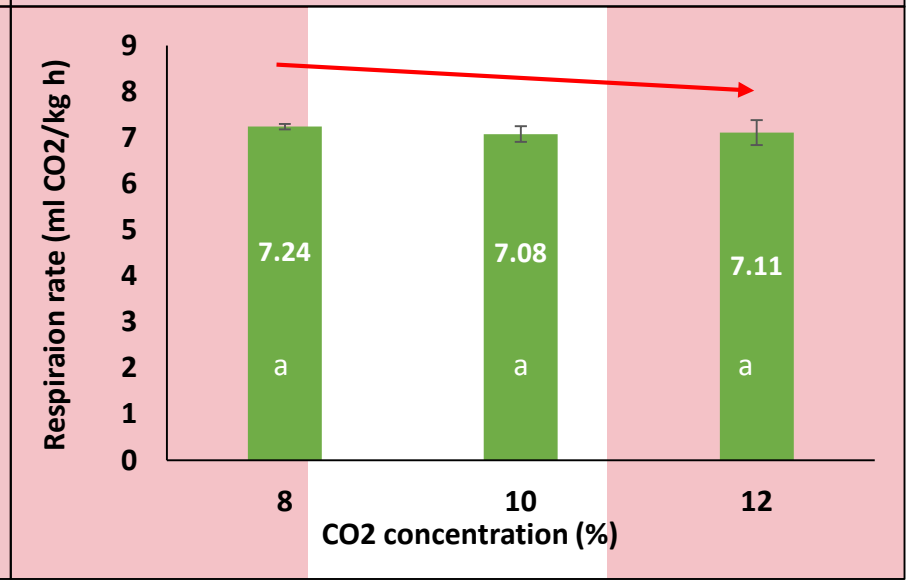
Maarten L.A.T.M. Hertog *, Sue E. Nicholson, Kerry Whitmore 1, 2003

Carbon dioxide effect on respiration rate









There is a clear relation between CO2 concentration and respiratory rate.

What are the differences between countries?

Too many ….

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What are the differences between countries?

Too many ….

Production altitude

Different climates

Managment

Fruit size

Different destination countries

Condition issues

Different percentage of dry matter at harvest

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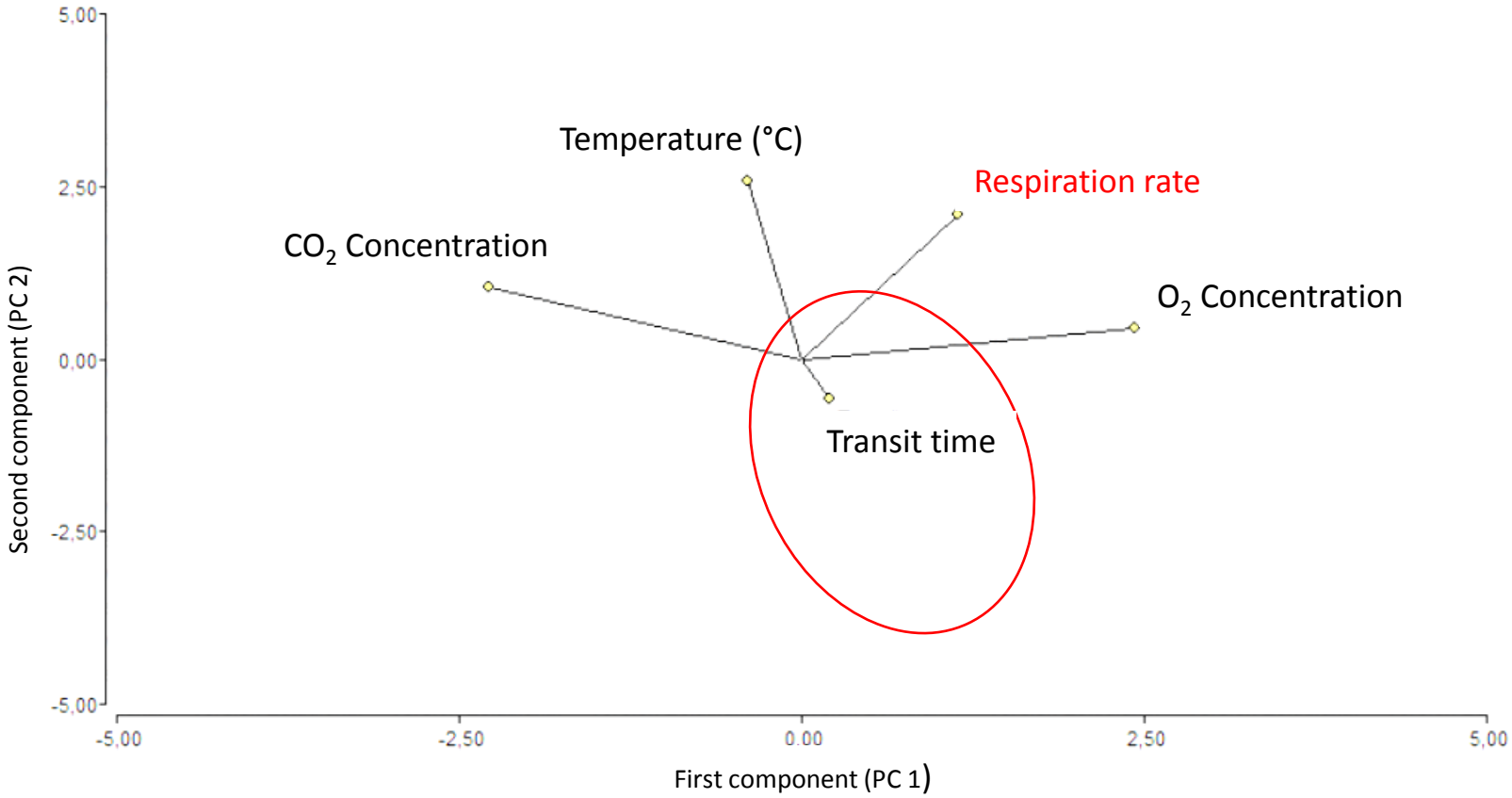
Chile

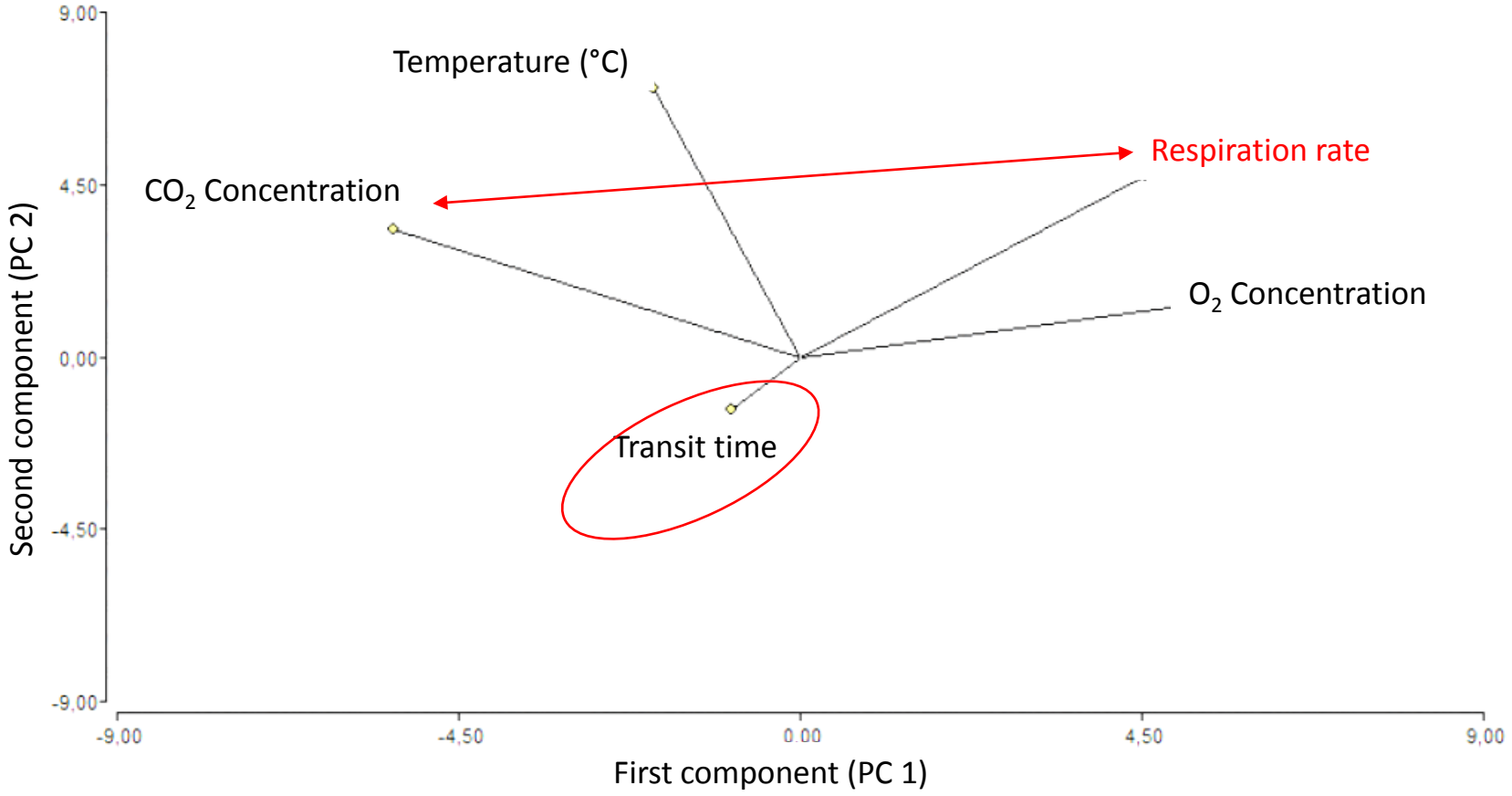
The objective is not to predict or study a response variable, but to study the correlation between variables.



- ✓ Indirect relationship between CO2 respectively and respiratory rate
- ✓ Transit time does not seem to be a component that explains the behavior of these variables.
- ✓ Temperature management does not present a greater relationship with respiratory rate

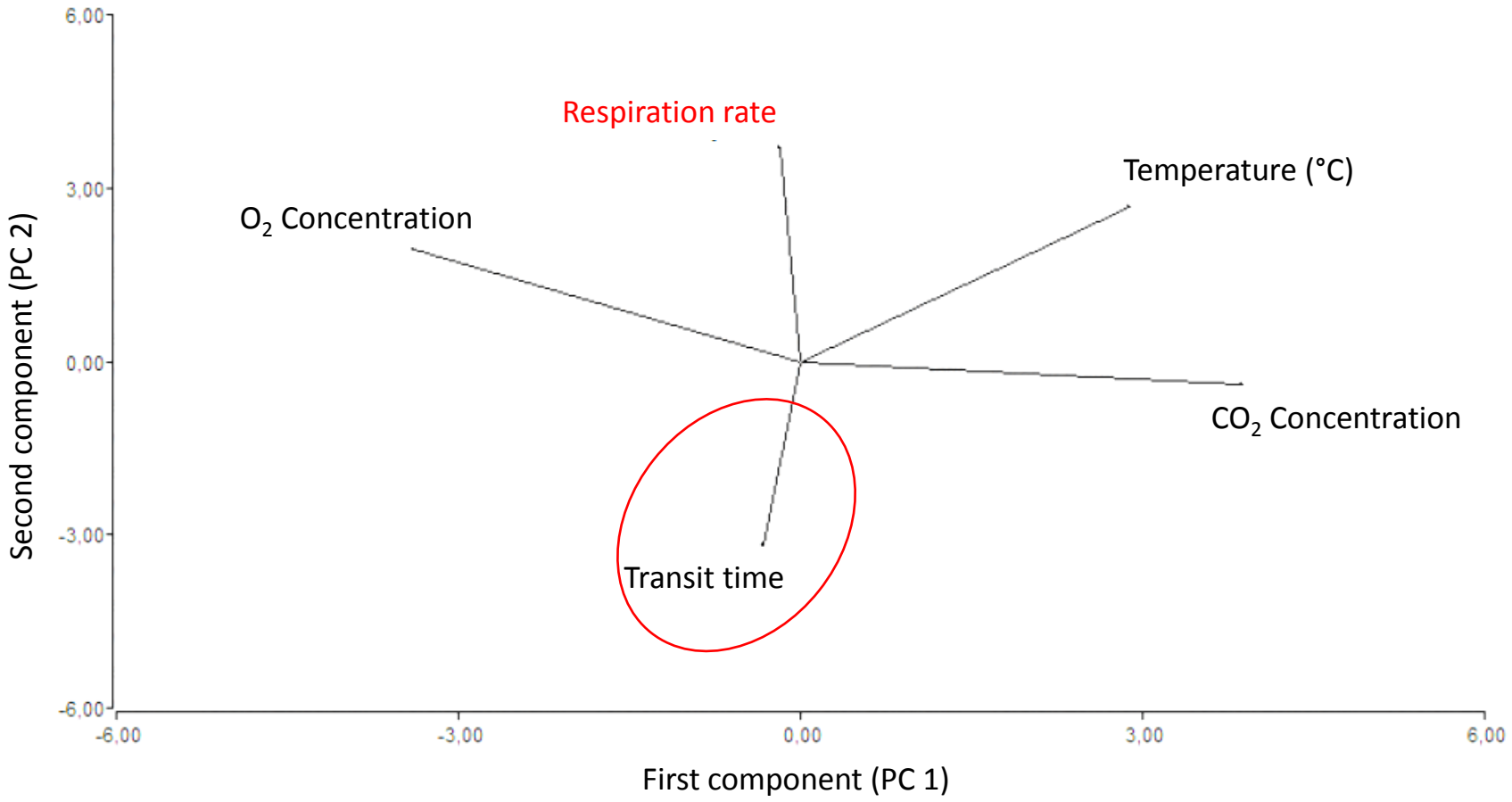
Temperature largely defines the respiratory rate of fruit and vegetable products.
Kader, 2014.

Colombia



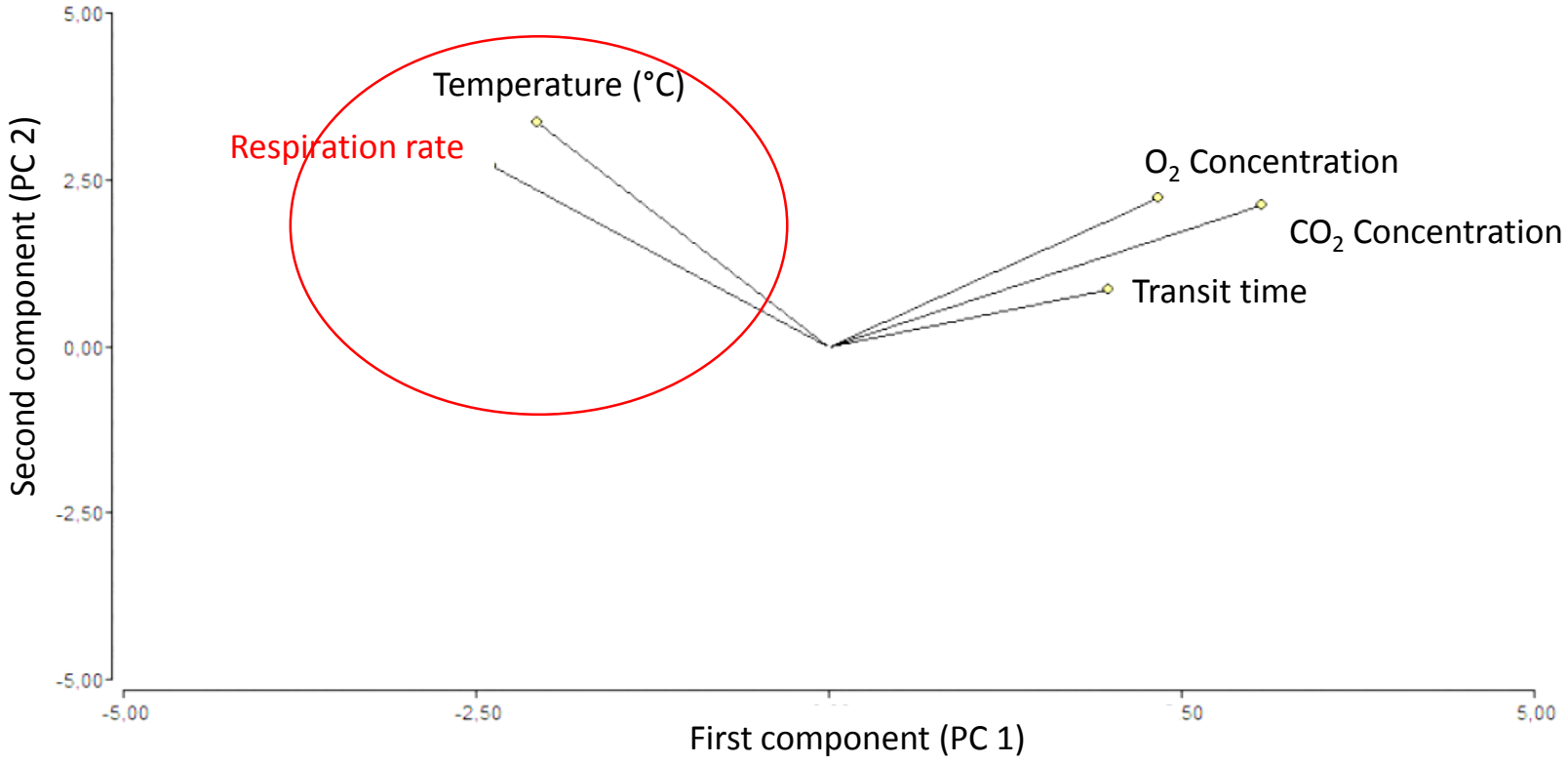
- ✓ Behavior of variables similar to Chile
- ✓ Greater sensitivity to CO2 modification
- ✓ Quick win: CO2 increase for respiratory rate decrease

Perú



- ✓ The relationship between CO2 and respiratory rate, but decreases.
- ✓ Increased importance and negative correlation with transit time- weird
- ✓ Less correlation with variables studied in general
- ✓ Other variables not studied:
  - Mean dry matter**
  - Heterogeneity **
  - Other Condition issues

South Africa

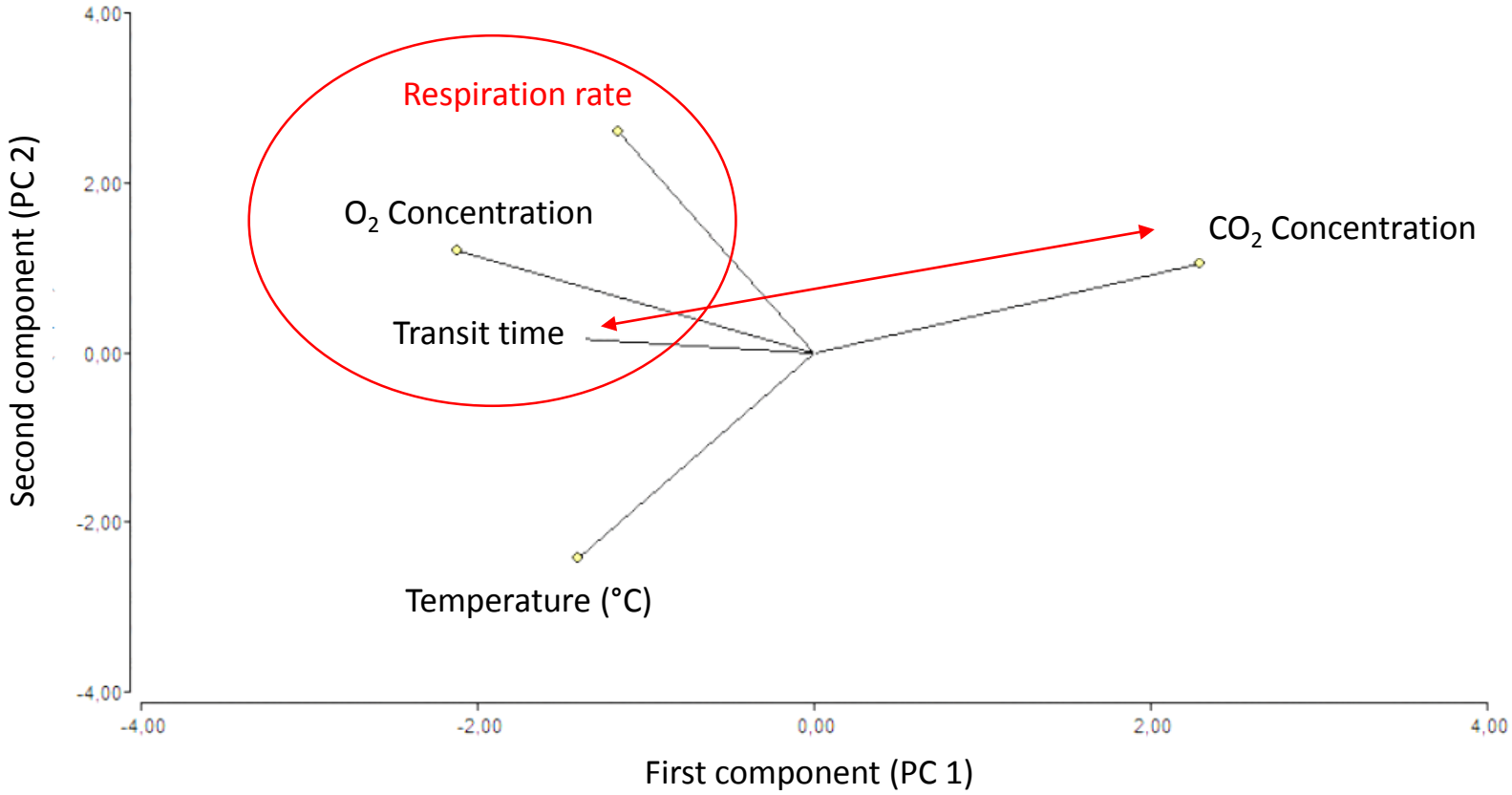


Higher correlation with temperature

Quick win possibility for the industry?

- Inadequate set point
- Possibility of improving stowage
- Dry matter

Mexico



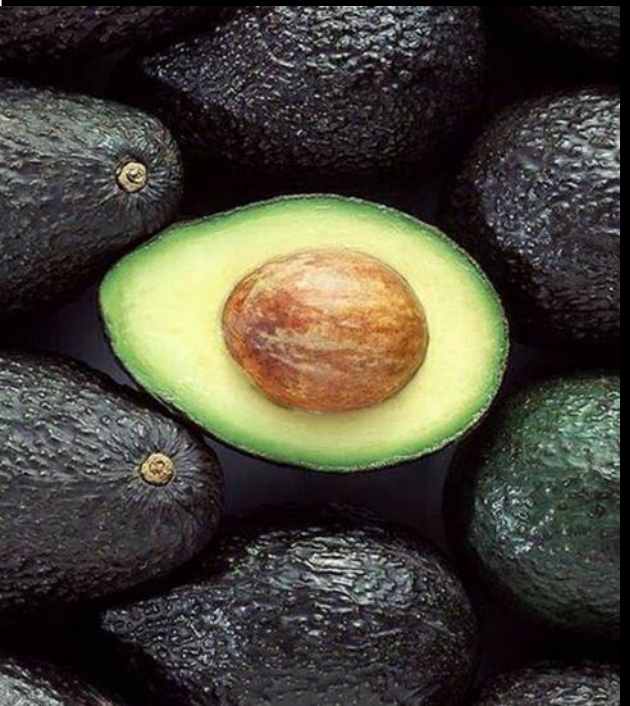
- ✓ Behavior of variables similar to Chile
- ✓ Greater sensitivity to CO2 modification
- ✓ Relation with CO2 and transit time (?)

Conclusion

- ✓**Increase the percentage of CO2** is a important strategy to decrease the respiratory
- ✓It is possible to categorize different avocado exporting countries based on their respiratory metabolism.
- ✓Each country has different considerations from a logistics point of view, quality, condition and raw material. **The recommendation must be specific.**

Next steps !

- ✓How does the respiratory rate vary during transit?
- ✓What effect does the different concentrations of CO2 have during maturation?
- ✓Even more specialized recommendations



Thanks you!

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