

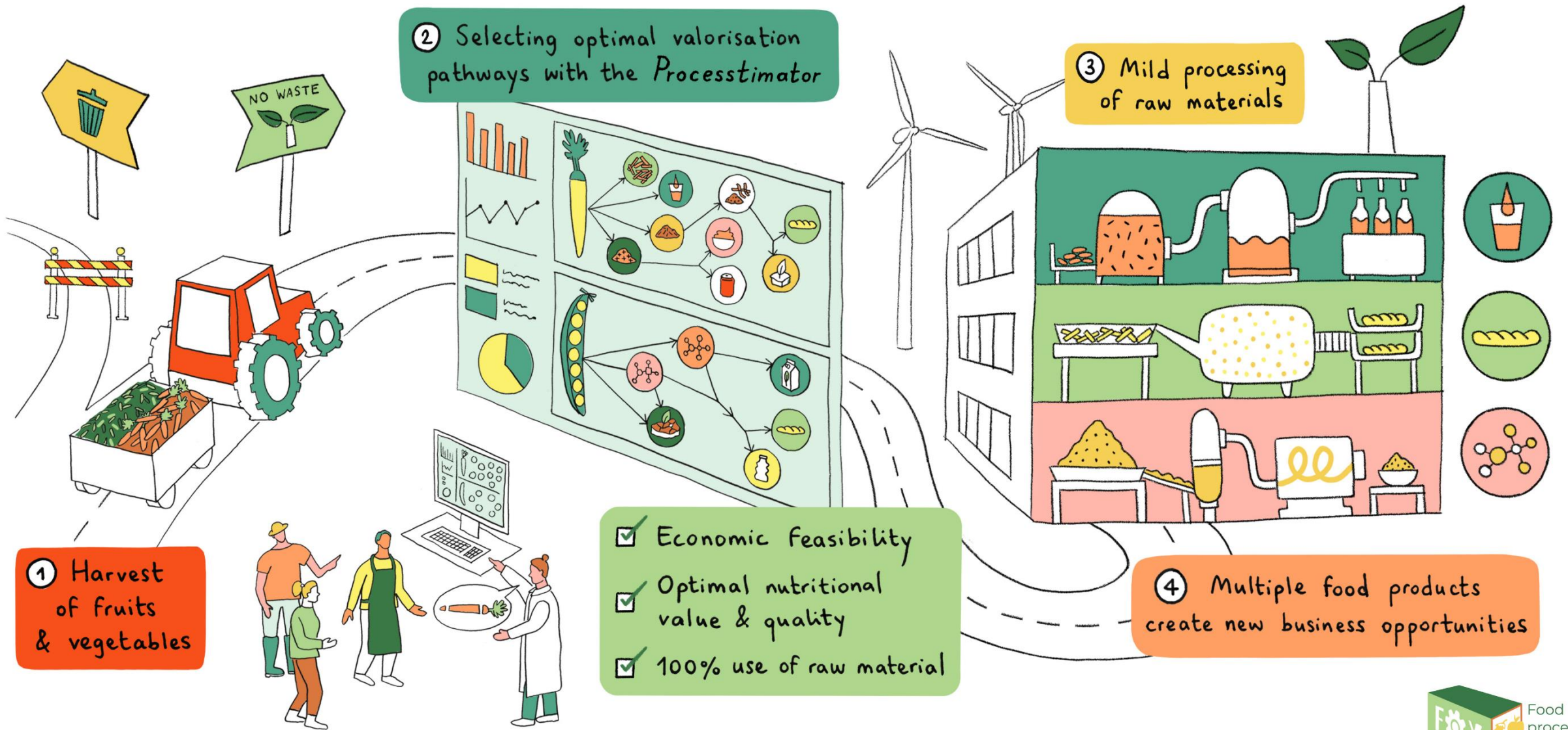


Upcycling plant side streams using mild processing:  
FOX *Processtimator* tool advises on feasibility of an additional washing step for industrial carrot and ginger juice extraction

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# Zero waste by upscaling fruit & vegetable side streams



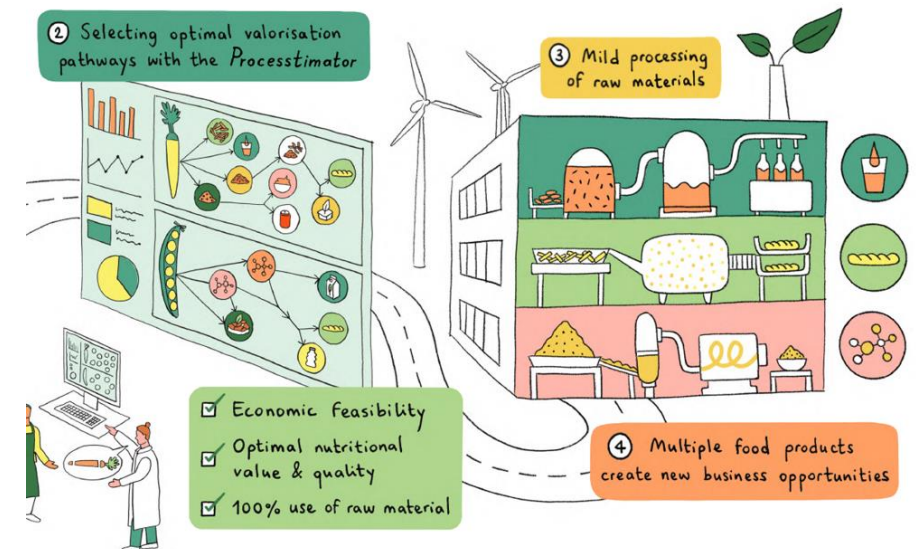


# Upcycling of side streams

To avoid loss of the food-graded material we can process these streams into more sustainable options (ingredients, food products or feed)

Questions for upcycling:

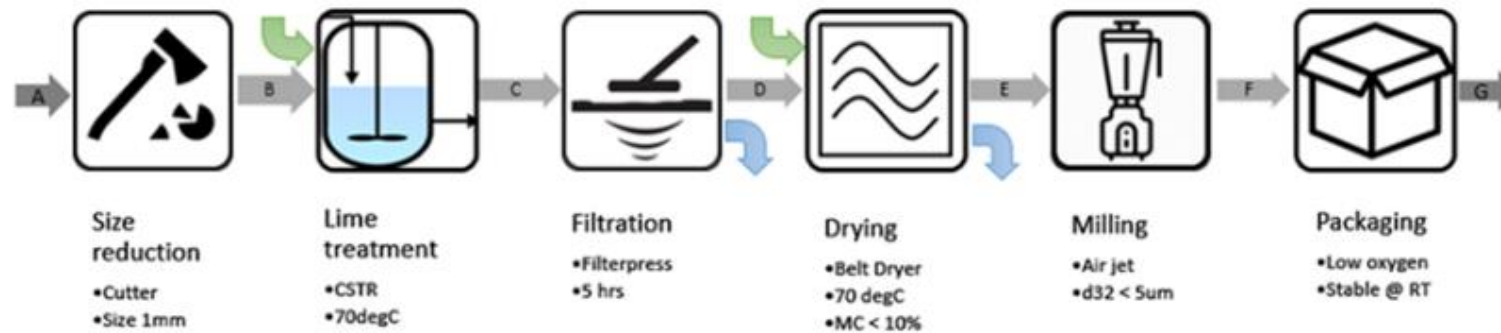
- Which process steps to take?
- Which products are generated?
- What are the properties of the products?
- Is this economically feasible?
- Is there a positive contribution to sustainability?





# Processtimator

- Design upcycling process for specific side stream (composition, volume):
  - Processing steps and equipment

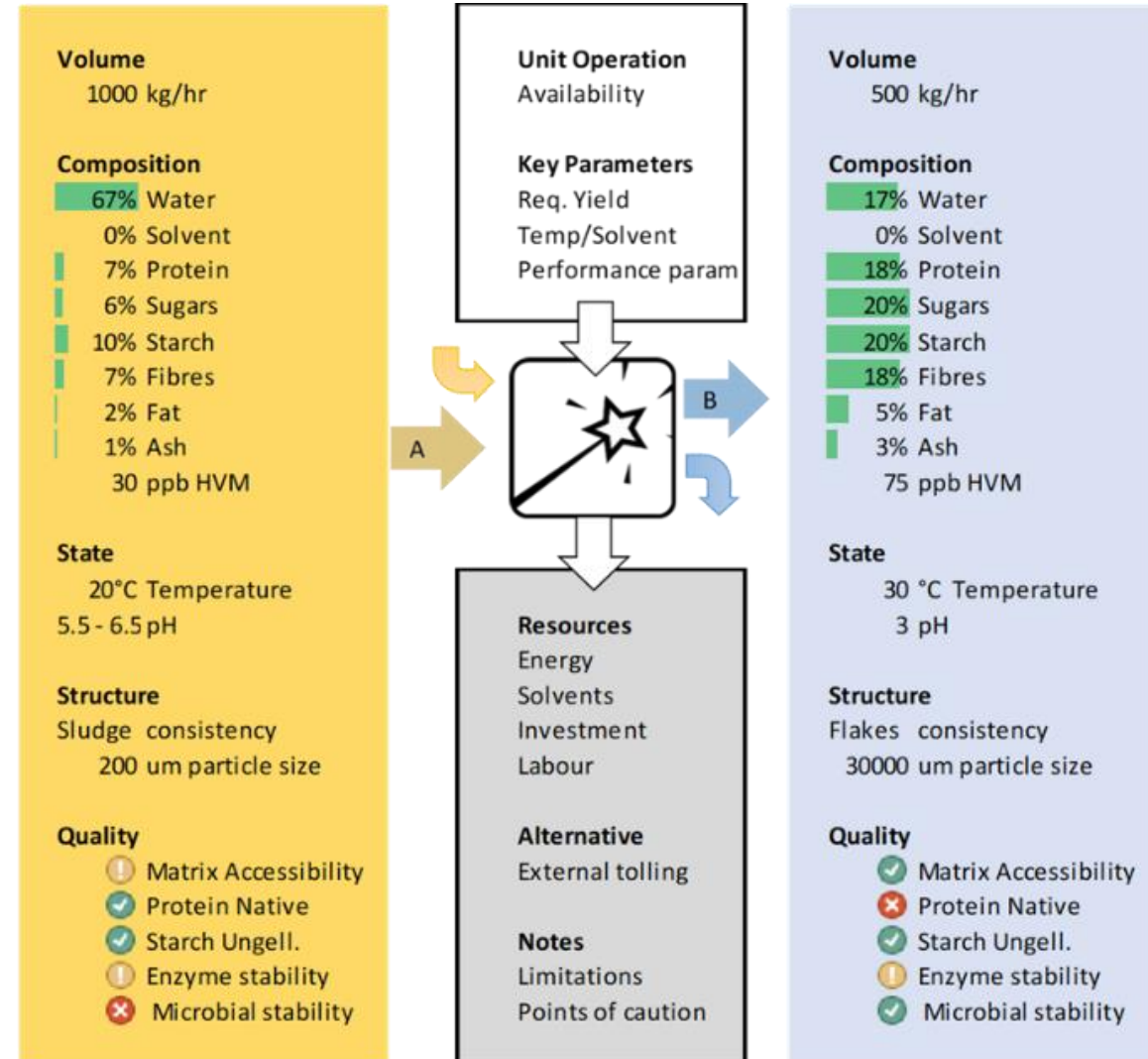


- Processing costs
- Environmental impact (CO<sub>2</sub>-equivalents)



# Processtimator

- While keeping track of:
  - Composition of streams in macro nutrients and minor components of interest
  - Structure
  - Quality aspects





# Processtimator



- Total use  
*(costs and benefits all fractions)*
- Mild processing  
*(diverse (mild) processes available)*
- Expert tool  
*(food technologists)*



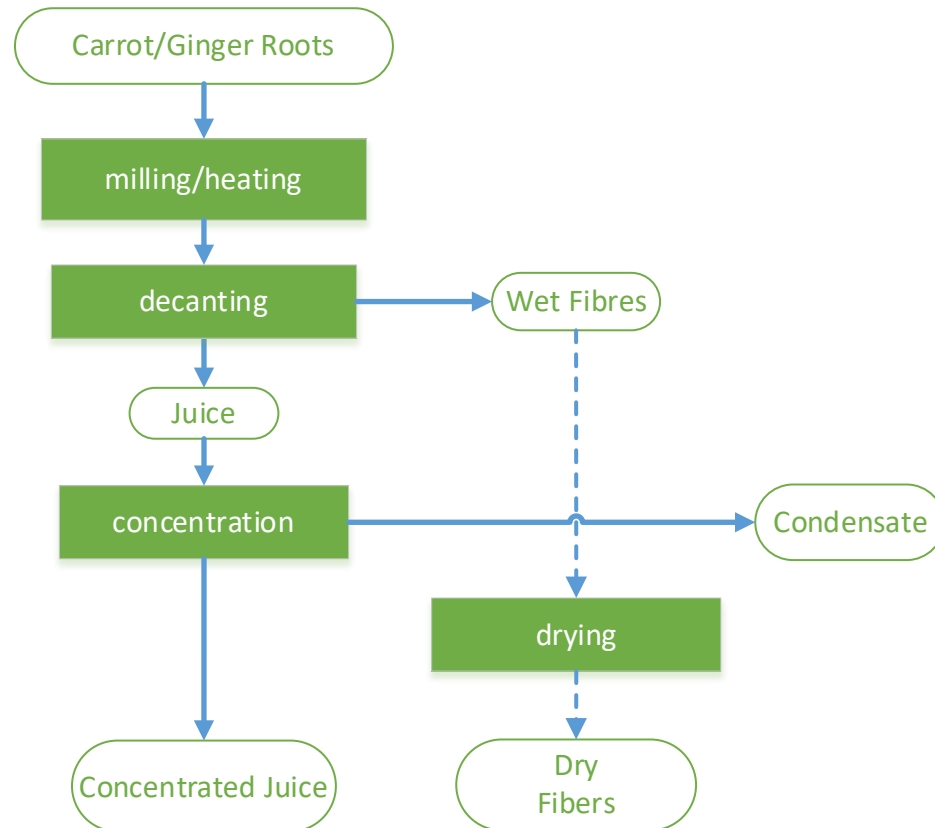
- Modular design  
*(coupling between processes, automatic updates)*
- Advise on process choice  
*(suitability of processes for material)*
- Coupling with relevant databases  
*(composition, feed value, processing costs)*



- Multiple outputs  
*(costs, energy and water, quality properties, CO<sub>2</sub> footprint)*
- Scenario analyses  
*(for example on input volumes, composition, yields)*



# Production process carrot juice & ginger juice





# Processtimator output carrot

Streams In	Volume	Price	Pricing Source
Carrot raw	4000 MetricTon/year	0.10 €/kg	Known price DDP

Streams Out	Volume	Price	Outlet
Concentrated carrot juice	652 MetricTon/year	1.01 €/kg	Primary stream (Calculate)
Dry carrot fibre	152 MetricTon/year	1.45 €/kg	Primary stream (Calculate)

process step			streams in	streams out	capital costs	man power	electricity	gas	steam	water
	<b>total k€/year</b>	<b>849</b>	<b>400</b>	<b>0</b>	<b>230</b>	<b>30</b>	<b>37</b>	<b>0</b>	<b>152</b>	<b>0</b>
0 Ca01_0START	48%	407	400			7				
1 Ca01_1knife cutter	1%	10			2	3	5			
2 Ca01_2colloid mill	5%	41			10	3	28			
3 Ca01_3(pressure) cooking	4%	37			17	3			16	
4 Ca01_4decanter	4%	35			28	3	4			
5 Ca01_5evaporator	25%	209			119	6			84	
6 Ca01_6pneumatic, flash dryer	13%	110			53	6			51	
7		0								







# Reference scenario

Streams in	Volume (MetricTon/year)	Price (€/kg)
Carrot fresh	4000	0.10

Streams in	Volume (MetricTon/year)	Price (€/kg)
Ginger root fresh	4000	0.70

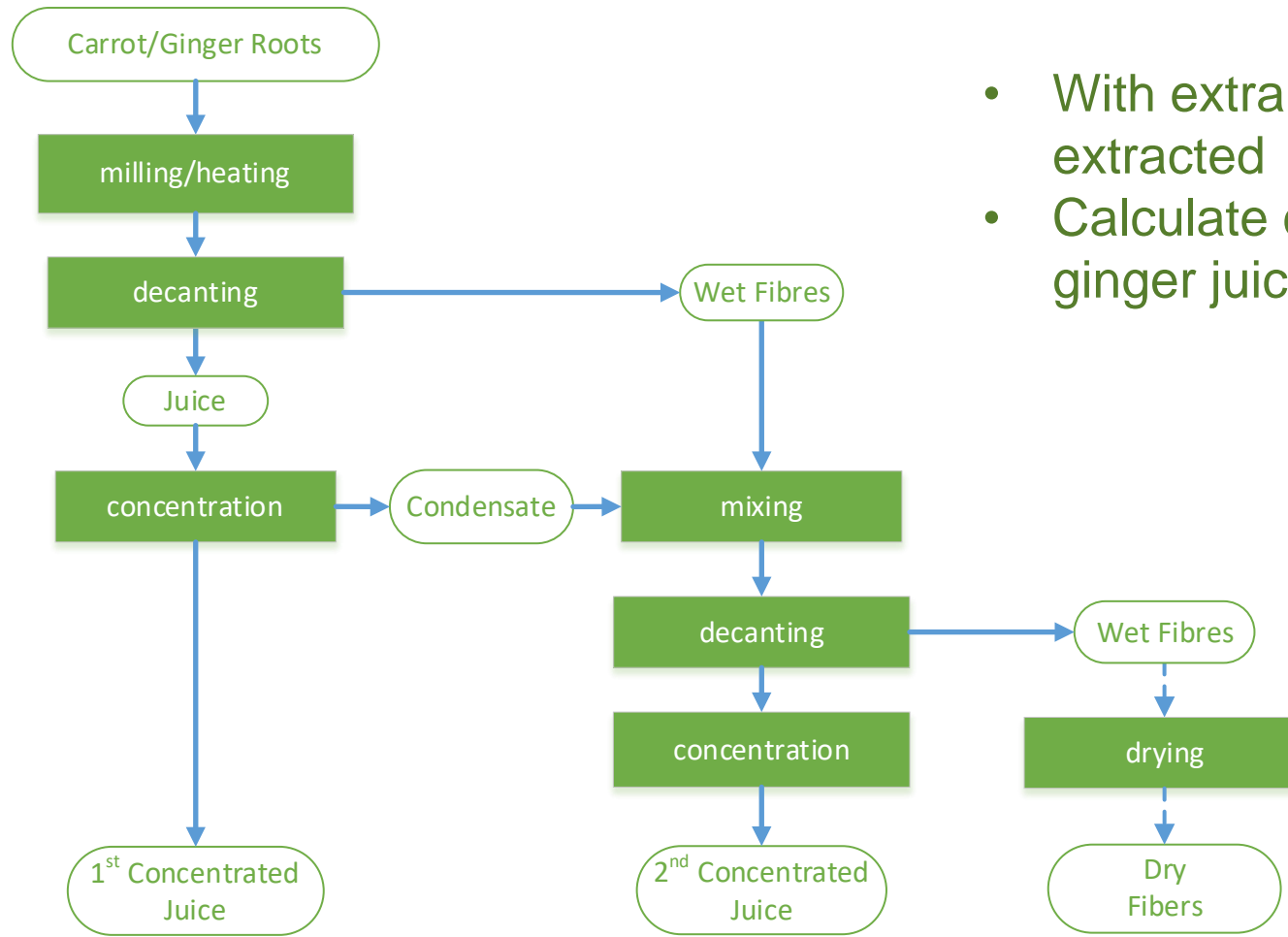
Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
Concentrated carrot juice	652	1.01	Main product
Dry carrot fibre	152	1.45	Main product

Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
Concentrated ginger juice	1552	2.02	Main product
Wet ginger fibre	657	-0.04	Digester





# Extra washing step



- With extra washing, more juice can be extracted
- Calculate costs for both carrot juice and ginger juice



# Carrot case

Streams in	Volume (MetricTon/year)	Price (€/kg)
Carrot fresh	4000	0.10

## Reference

Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
Concentrated carrot juice	652	1.01	Main product
Dry carrot fibre	152	1.45	Main product

## Extra washing

Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
1 <sup>st</sup> Concentrated carrot juice	652	1.01	Main product
2 <sup>nd</sup> Concentrated carrot juice	123	2.64	Main product
Dry carrot fibre	99	1.45	Main product



- Extra carrot juice is more expensive per kg, thus less interesting
- Less fibre to sell



# Ginger case

Streams in	Volume (MetricTon/year)	Price (€/kg)
Ginger root fresh	4000	0.70

## Reference

Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
Concentrated ginger juice	1552	2.02	Main product
Wet ginger fibre	657	-0.04	Digester



## Extra washing

Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
1 <sup>st</sup> Concentrated ginger juice	1552	2.02	Main product
2 <sup>nd</sup> Concentrated ginger juice	220	1.29	Main product
Wet ginger fibre	545	-0.04	Digester

## Extra washing + drying ginger fibre

Streams out	Volume (MetricTon/year)	Price (€/kg)	Outlet
1 <sup>st</sup> Concentrated ginger juice	1552	2.02	Main product
2 <sup>nd</sup> Concentrated ginger juice	220	1.29	Main product
Dry ginger fibre	144	0.13	Main product

- Extra washing step for ginger is economically interesting, and drying the fibres is relatively cheap.



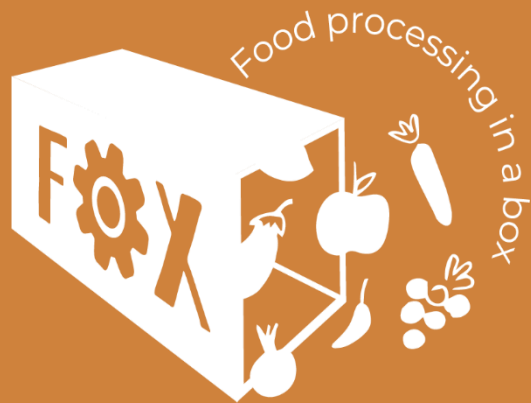


# Conclusions

- The carrot juice and ginger juice cases illustrate that the benefits of process adjustment may differ per crop
- Advantages of the *Processtimator* tool
  - Quick and detailed output
  - Provides information that can help decision making before starting expensive and time-consuming tests



Thanks for your  
attention!



## Contact information

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