



# REVTECH PROCESS SYSTEMS

## Heat treatment technology

IAOM

July 26<sup>th</sup> – Branson, MO

August 8<sup>th</sup> – Brainerd, MN

Celia Schlosser

# PRODUCT RECALLS



Pathogen	Year	Number of cases	Isolated from product?	Outbreak location(s)
E. coli O121, E. coli O26	2015–2016	63	yes	USA (24 states)
E. coli O121	2016–2017	30	yes	Canada (6 provinces)
E. coli O121	2017	6	yes	Canada (1 province: BC)

What is the common point ?

# PRODUCT RECALLS

Product : Flour	Pathogen	Year	Number of cases	Isolated from product?	Outbreak location(s)
General Mills, Kansas City, MO	E. coli O121, E. coli O26	2015– 2016	63	yes	USA (24 states)
Ardent Mills, Saskatoon, SK	E. coli O121	2016– 2017	30	yes	Canada (6 provinces)
Rogers Foods, BC	E. coli O121	2017	6	yes	Canada (1 province: BC)

Flour !

E. Coli !



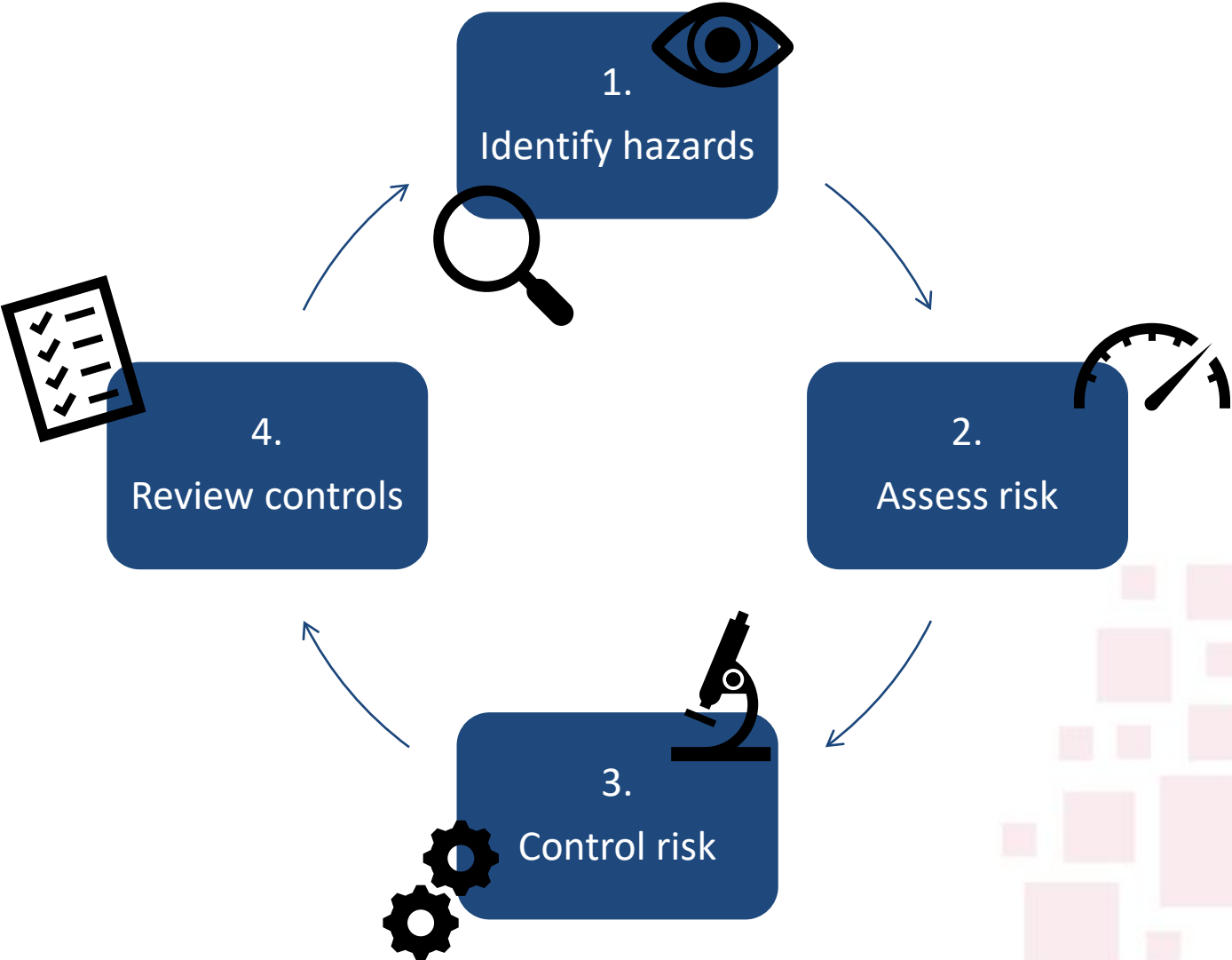
# RISK ASSESSMENT PROCESS

Pasteurization

Modification of  
flour properties

Stabilization

Roasting



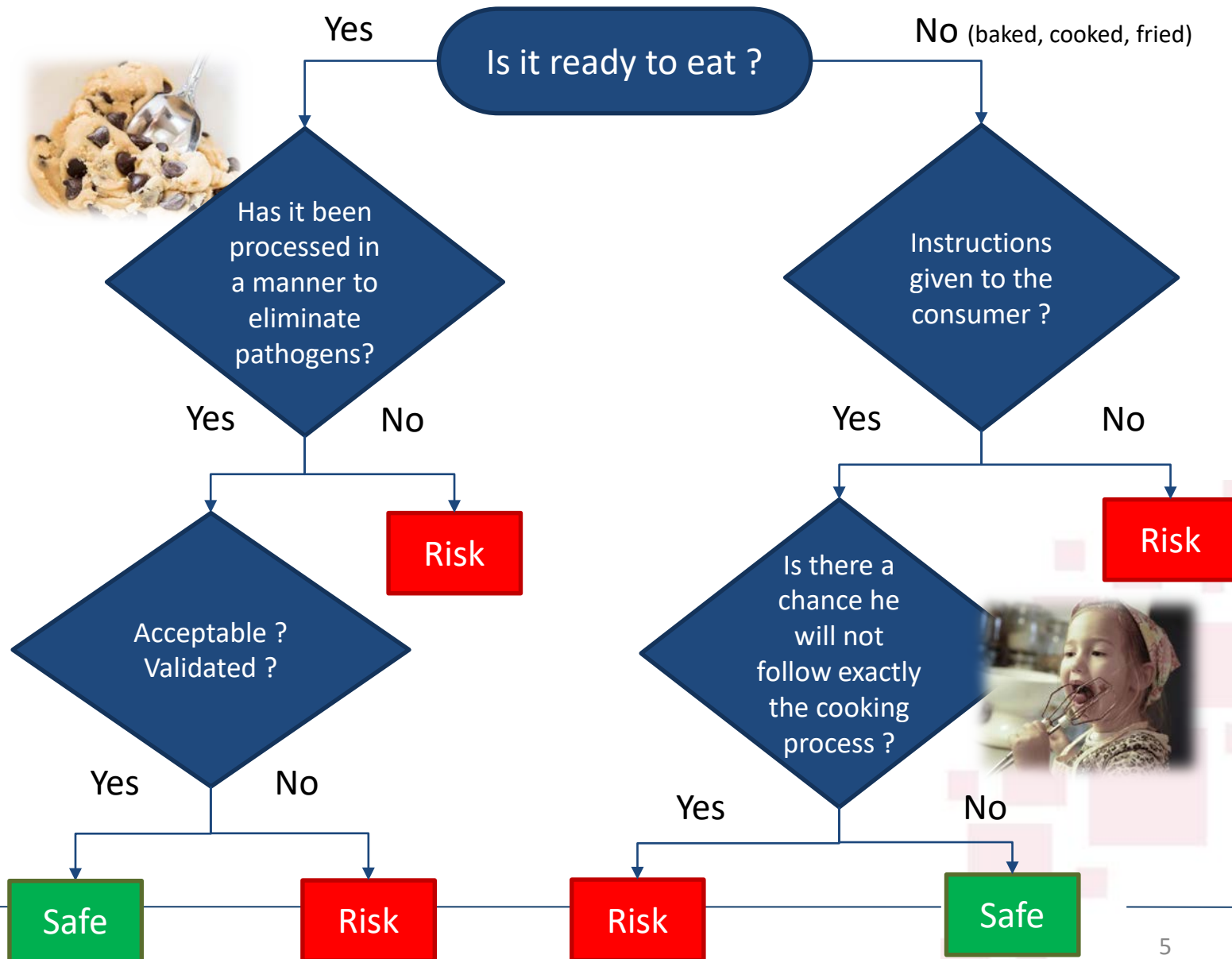
# WHY ? IDENTIFY HAZARDS

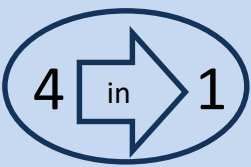
Pasteurization

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# WHY ? ASSESS RICK



Pasteurization

2009, 77 people reported as sick, 30 states  
Toll House Cookie Dough, Nestle  
Was written not to eat before warm up  
FDA found E. Coli in chocolate chip cookie dough  
**> 3.6 million packages recalled**

*Neil & al., 2011*

Modification of  
flour properties

Survey: 1,032 individuals in the United States

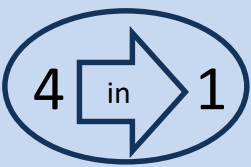
➔ **58%** of consumers have tasted refrigerated rough before baking

*ConAgra Mills, 2011*

Stabilization

Roasting

2010 : Nestle, USA decided using only heat-treated  
flours for refrigerated dough products



# IS IT GOING TO EXTEND?



## Against

- Majority still going through kill step
- Low moisture / water activity
- Low level of microorganisms
- Adverse effect on flour functionality/quality
- Cost

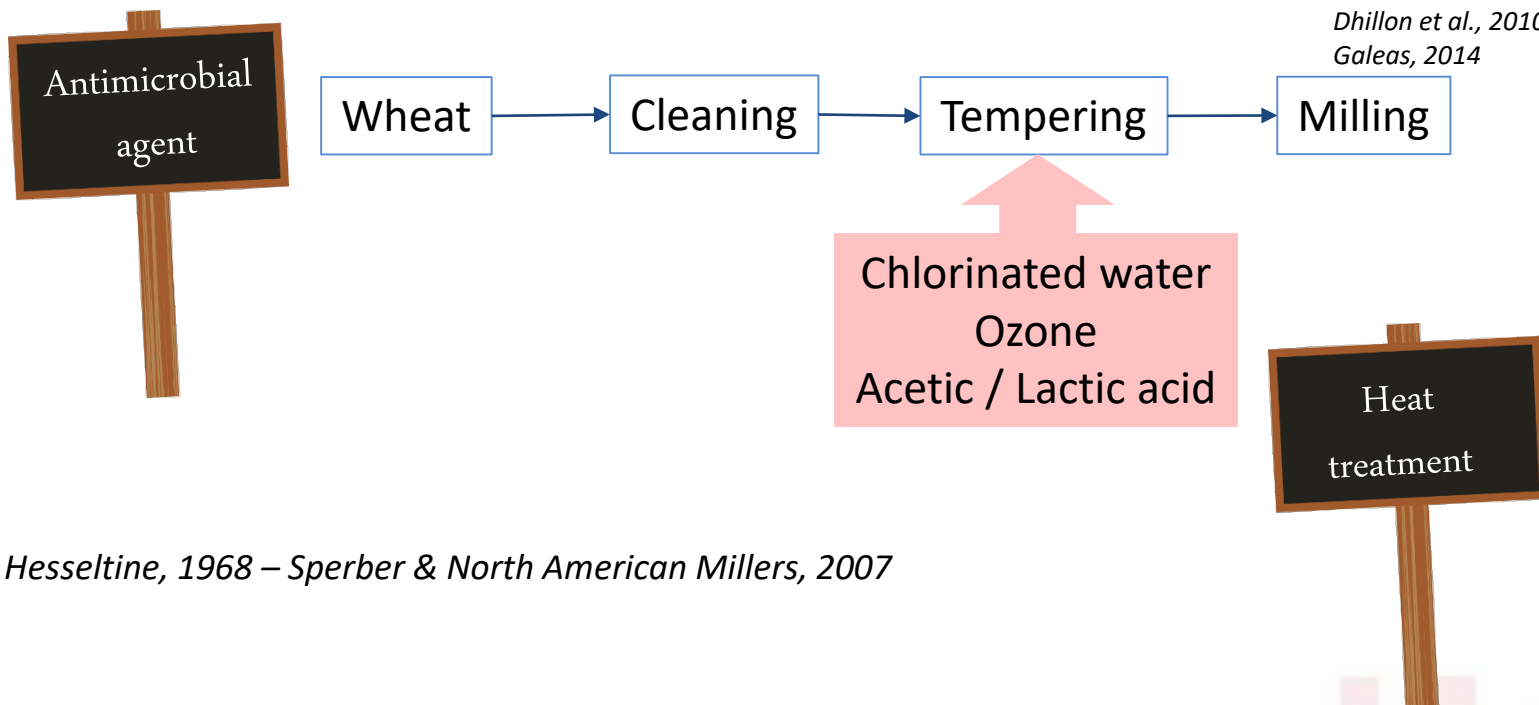
## For

- Product recalls
- Can be exposed to pathogens in soil/water or from birds/animals
- Can be impacted by wet harvest period / low harvest temperature
- Increase for wholegrain foods (might reduce obesity, cardio vascular disease, diabetes...)
- Can be eaten raw
- Can be added to foods that will not be cooked (milkshakes, ice cream...)

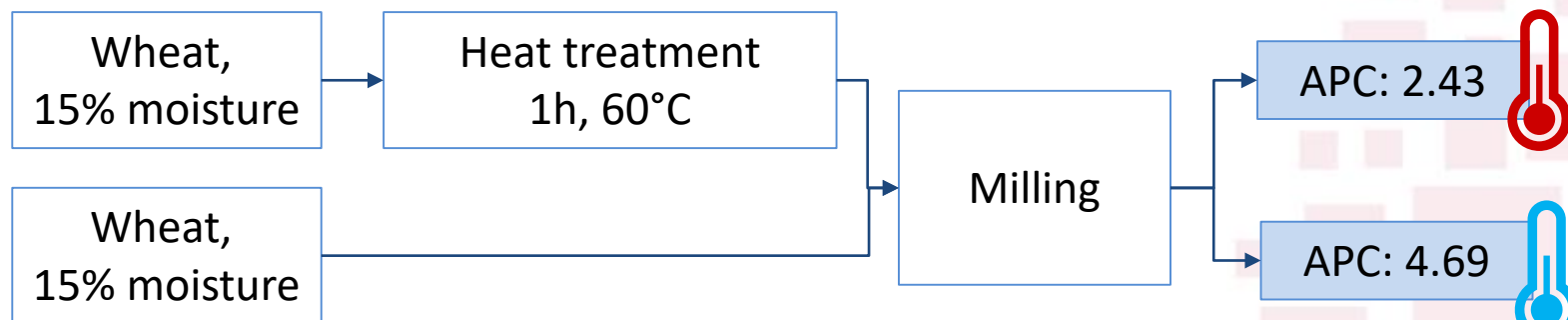
4 in 1

# HOW TO CONTROL THE RISK ?

*Dhillon et al., 2010  
Galeas, 2014*



*Hesseltine, 1968 – Sperber & North American Millers, 2007*





4 in 1

# HOW TO CONTROL THE RISK ?

Pasteurization

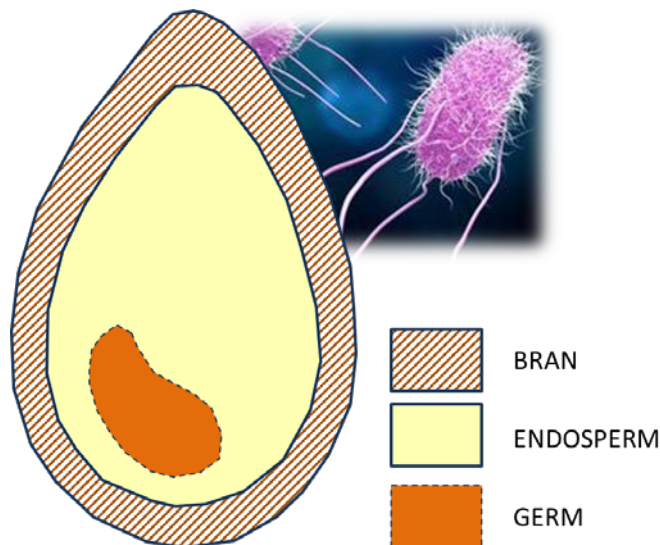


Higher contamination  
on the outer layers

*Miskelly & al., 2010*

Higher risk  
for **whole** wheat flour

Modification of  
flour properties



Heat treat wheat kernels outer layers



Reduce microbiological load



Mill into flour

Stabilization

Roasting

# THE REVTECH TECHNOLOGY

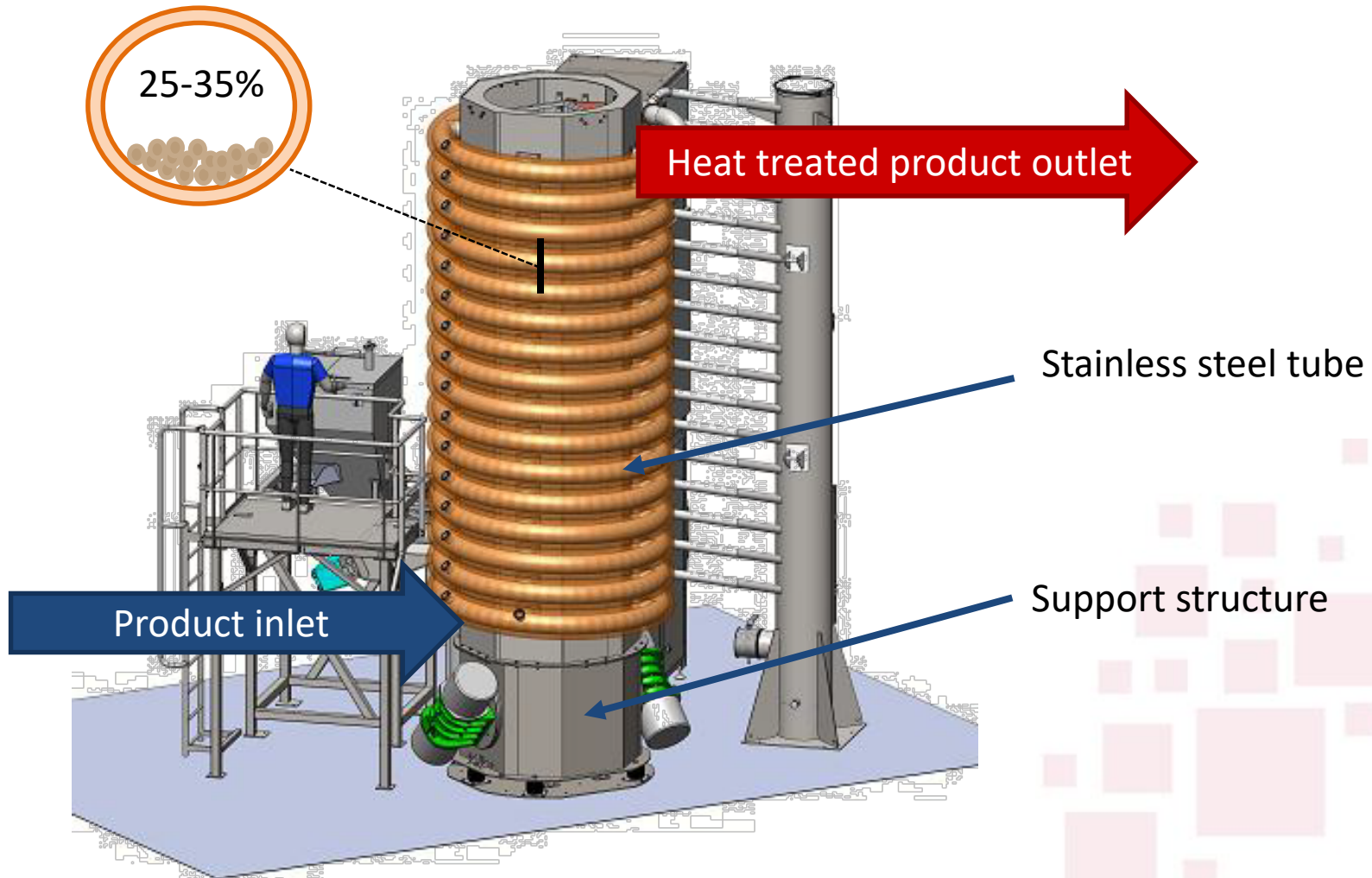
4 in 1

Pasteurization

Modification of  
flour properties

Stabilization

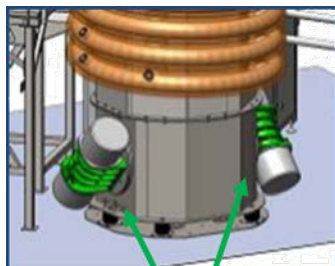
Roasting



4 in 1

# THE REVTECH TECHNOLOGY

Pasteurization



Off balanced motors

Frequency: ~ 12 Hz  
Amplitude: ~ 4 mm  
Acceleration: ~ 4 g

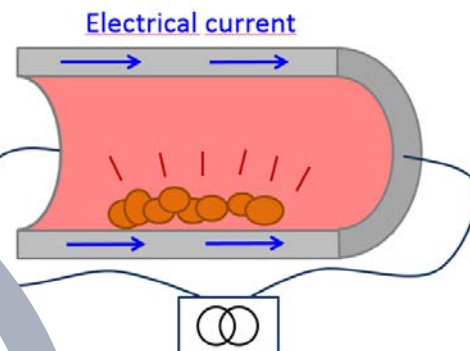
Modification of  
flour properties

Stabilization

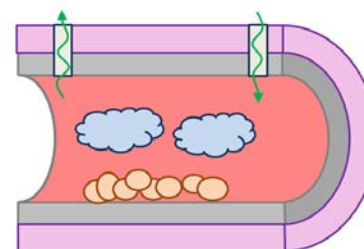
Roasting



1. Transportation / mixing by vibrations
2. Heating by direct contact with a hot surface
3. Treatment in a confined atmosphere



High current  
Low voltage < 40V



# THE REVTECH TECHNOLOGY

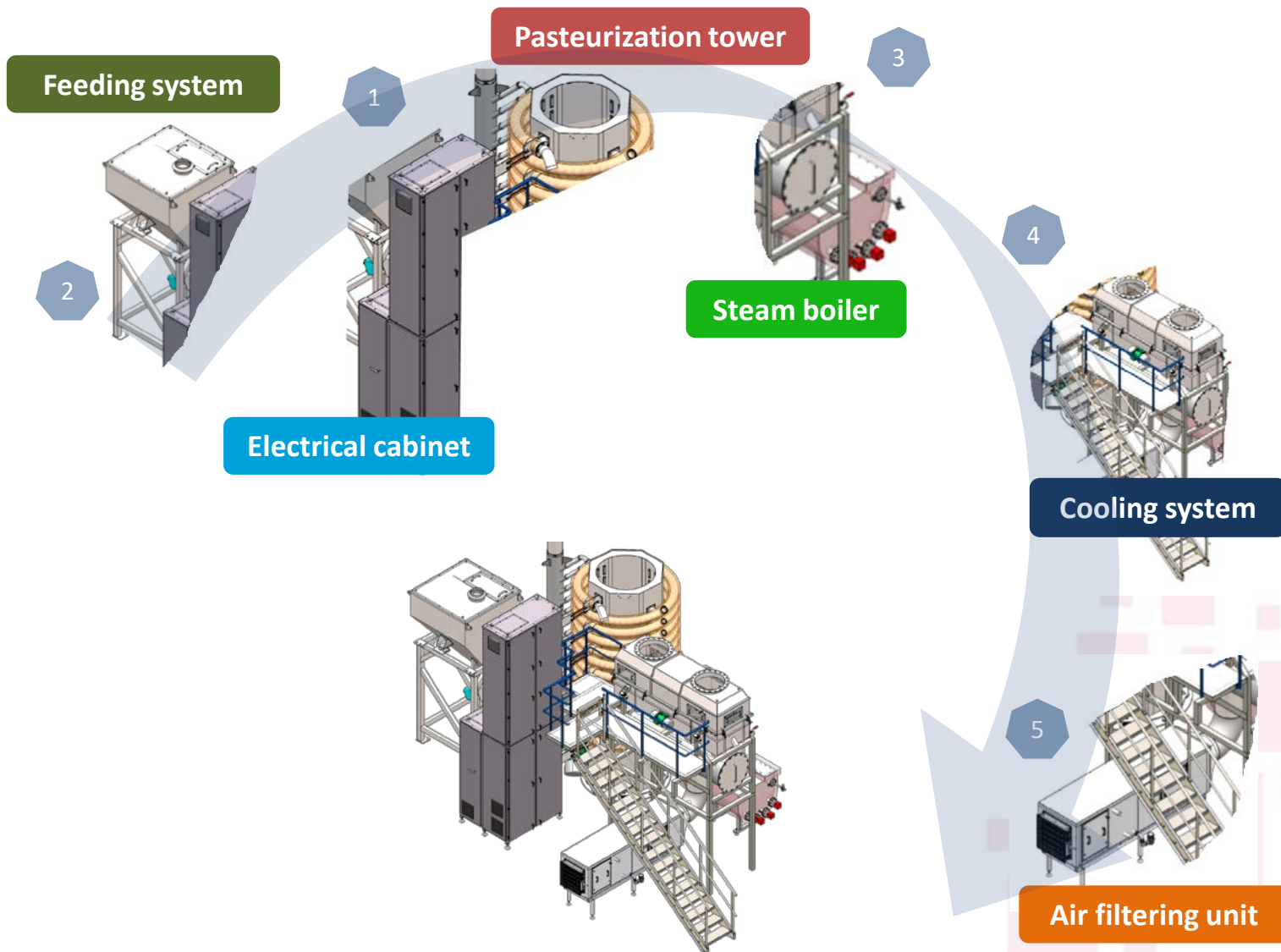


Pasteurization

Modification of  
flour properties

Stabilization

Roasting



4 in 1

# THE REVTECH TECHNOLOGY

Pasteurization

Modification of  
flour properties

Stabilization

Roasting

## Flowrate

200 lbs/h to  
-4,000 lbs/h (flour)  
-11,000 lbs/h (grains)

## Temperature

100 to 800°F

with 2 to 4  
independent  
heating zones

## Residence time

1 to 40 mn

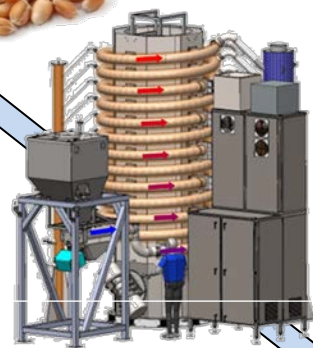
## Atmosphere

air, steam,  
nitrogen...



4 in 1

# REVTECH RESULTS



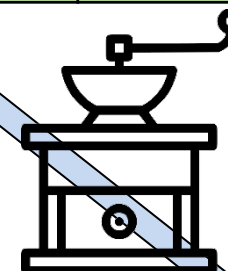
Pasteurization

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Roasting

					Average of 3 Samples		
Product	Conditions	Residence time	Steam	Tube temperature	TPC (cfu/g)	Enterobacteria (cfu/g)	Yeasts & Molds (cfu/g)
Wheat grains	Raw material				140 000	12 000	1 600
	Revtech 1	5 min	10%	210°F	< 10	< 10	< 10
	Revtech 2			240°F	< 10	< 10	< 10
	Revtech 3			265°F	< 10	< 10	< 10



5 log TPC  
< 10 for Enterobacteria / Yeasts & Molds  
Safer wheat flour !

# REVTECH RESULTS

Product	Conditions	Residence time	Tube temperature	TPC (cfu/g)	Enterobacteria (cfu/g)	Yeasts & molds (cfu/g)
Wheat flour	Raw			2 000	510	320
	Raw			5 000	1 500	300
	Raw			2 300	120	150
	Low temp	5 min	160°F	750	250	100
		10 min		610	< 40	< 40
		15 min		720	~ 40	< 10
	Medium temp	5 min	175°F	430	< 40	~ 40
		10 min		170	~ 40	< 10
		15 min		150	< 10	< 10
	High temp	5 min	190°F	< 400	< 10	< 10
		10 min		< 40	< 10	< 10
		15 min		< 40	< 10	< 10

Pasteurization works on wheat flour as well !



But higher surface/volume ratio  
 ➔ Higher contact with heat  
 ➔ Might change flour properties

4 in 1

# IMPROVING FLOUR PROPERTIES

Chlorinated / Bleached flours



1200-2500 ppm

pH : 4.6-5.1 ( $\approx$  6.0 for untreated flour)



Texture

↘ Stickiness, ↗ aeration

Color

↗ Crumb color, whiter flour

Starch

↘ Gelatinization T

Protein

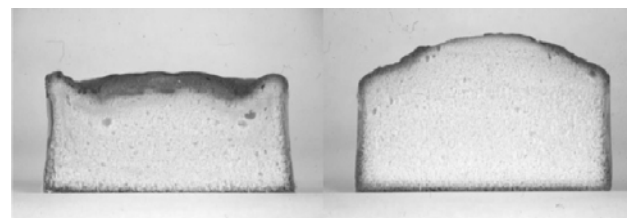
↘ Gluten network strength



Carcinogenic effect

Must be labelled

High ratio cakes



Untreated

Chlorinated

**BANNED**

in EU, Canada, UK, Japan and China



# REVTECH RESULTS

Pasteurization

Modification of  
flour properties

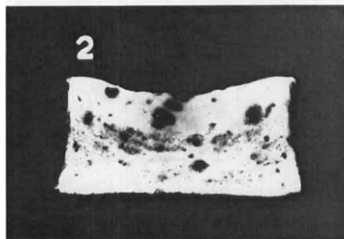
Stabilization

Roasting

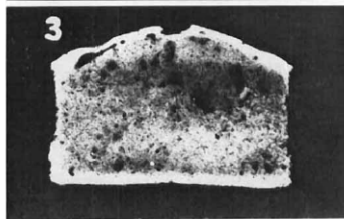
*Russo et al., 1970*



Chlorinated flour



Untreated flour



Heat treated flour  
(Drum, 250°F)

*Keppler, 2017*



Untreated flour



Revtech  
230°F, 10:45min



Revtech  
300°F, 9:50min

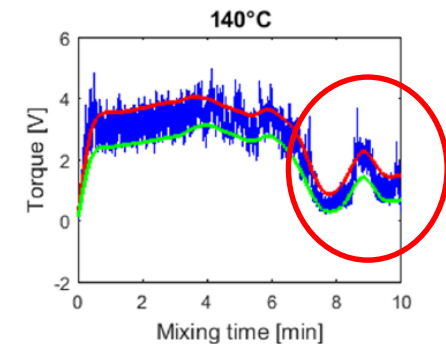
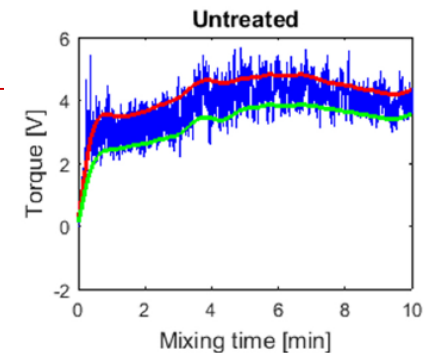
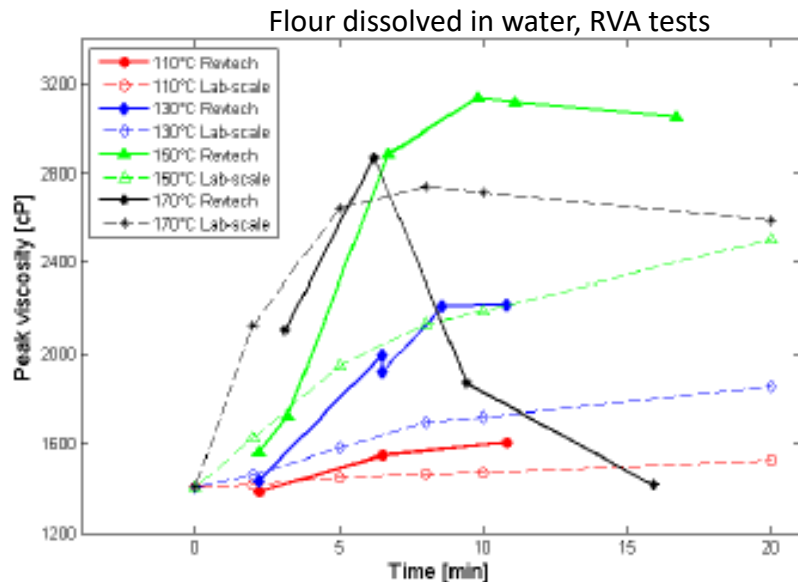
# REVTECH RESULTS

Pasteurization

Modification of  
flour properties

Stabilization

Roasting



Rheometer tests

Temperature

Processing time

Easier for granules  
to swell ?



Viscosity

Instability of gluten network

# WHAT ABOUT BRANS / GERMS ?

4 in 1

Pasteurization

Modification of  
flour properties

Stabilization

Roasting



Raw brans / germs

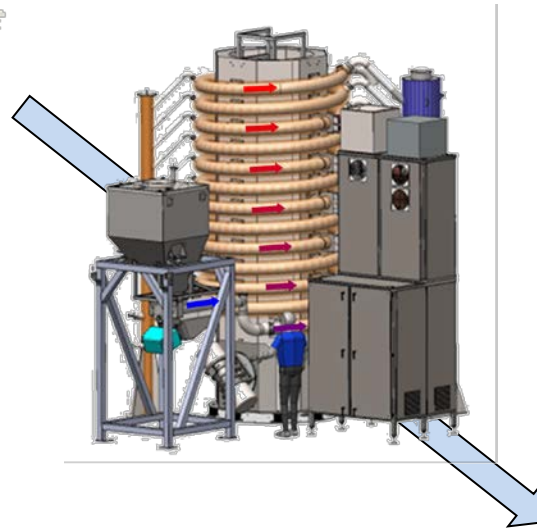
Source of fibres

High enzyme activity:  
Lipase + Lipoxygenase

Short shelf life



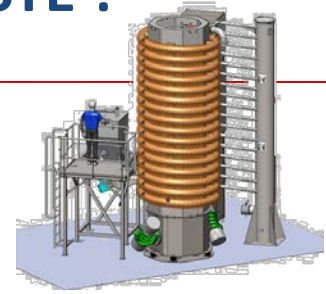
About  
250°F, 10 minutes



Enzyme inactivation

↗ Shelf life

# AND IF I WANT TO CHANGE COLOR/TASTE ?



Temperature around 150 to 250°C / 300 to 480°F

Residence time around 10 to 20 mn



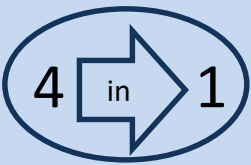
*Wheat flour - 430°F, 0 – 3 – 6 – 9 – 15 – 30 mn*



*Milled wheat bran: 430°F, 0 – 3 – 6 – 12 – 18– 24 mn*



*Wheat germs: 350°F, 0 – 6 – 9 – 12 – 21 mn*



Pasteurization

Modification of  
flour properties

Stabilization

Roasting

4 in 1

# CONCLUSION

More than **120 units** installed around the world

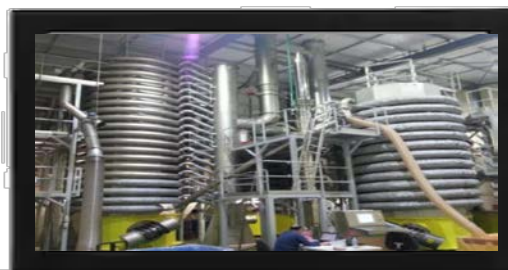




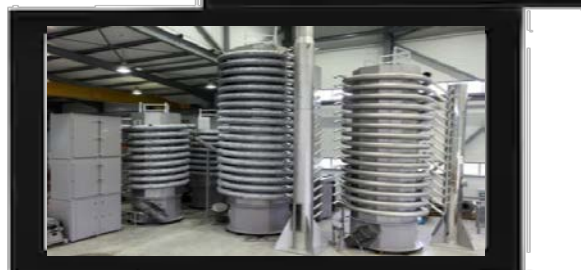
# CONCLUSION

More than **120 units** installed around the world

Pasteurization



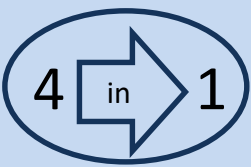
Modification of  
flour properties



Stabilization



Roasting



# CONCLUSION

Pasteurization

**4** applications, 1 equipment

Modification of  
flour properties

Great **homogeneity**

Only gentle vibrations (no auger, belt mixer)

Stabilization

Works for small **pieces and powders**

100 W/kg Pasteurization – 200 W/kg Roasting

Roasting

Every machine **can be validated** to FDA standards

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# THANK YOU

## Any question ?

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# References (ISO 690)

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- [ucfoodsafety.ucdavis.edu/files/271162.pdf](http://ucfoodsafety.ucdavis.edu/files/271162.pdf)