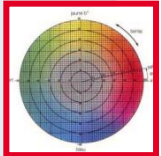


# Flour fortification in SEA – addressing technical concerns

4th Annual Southeast Asia District Conference  
October 8-10, 2013

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Research & Development Vitamin Premixes  
Stern-Wywiol Gruppe GmbH & Co. KG, Germany

# Agenda:






- Implementation of WHO guidelines
- Impact on colour
- Interaction with flour improvers

# WHO recommendation

Nutrient	Flour Extraction Rate	Compound	Level of nutrient to be added in parts per million (ppm) by estimated average per capita wheat flour availability (g/day) <sup>1</sup>			
			<75 <sup>2</sup> g/day	75-149 g/day	150-300 g/day	>300 g/day
Iron	Low	NaFeEDTA	40	40	20	15
		Ferrous Sulfate	60	60	30	20
		Ferrous Fumarate	60	60	30	20
		Electrolytic Iron	NR <sup>3</sup>	NR <sup>3</sup> 50	60	40
	High	NaFeEDTA	40	40	20	15
Folic Acid	Low or High	Folic Acid	5.0	2.6 2.0	1.3	1.0
Vitamin B <sub>12</sub>	Low or High	Cyanocobalamin	0.04	0.02	0.01	0.008
Vitamin A	Low or High	Vitamin A Palmitate	5.9	3	1.5	1
Zinc <sup>3</sup>	Low	Zinc Oxide	95	55 30	40	30
	High	Zinc Oxide	100	100	80	70

# Iron is not just iron










	Appearance	Iron content	Bio-availability	Reactivity
Electrolytic iron		97%	50-75%	↓
Ferrous fumarate		32%	100%	↑
Ferrous sulfate		32%	100%	↑↑

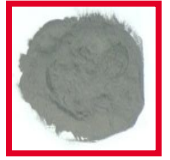
# Impact of different iron sources on final products



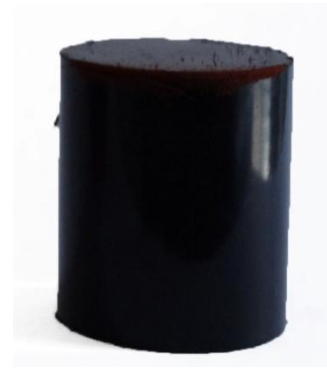
## Example: Pasta enrichment

	0	1	2	3	4	5	6
Iron source	Non-enriched	Ferric pyrophosphate	Ferric orthophosphate	Electrolytic iron	Ferrous fumarate	Ferrous sulfate	Ferric sodium EDTA
Relative bio-availability (WHO)		21-74%	25-32%	50-75%	100%	100%	>100%
Appearance compared to non-enriched pasta		Comparable	Comparable	Comparable	Brighter	Greyish	Much brighter
Pictures							

# Magnetism



- Electrolytic iron is ferromagnetic = constantly magnetic
- Ferrous fumarate is paramagnetic = magnetizeable

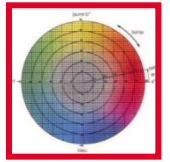


# Increased zinc level - Influence on the rheological characteristics

- Example: Wheat flour

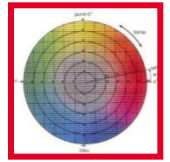
Active agent	Raw material	Content of active agent in flour (ppm)	FARINOGRAPH			EXTENSOGRAPH		
			WA	Development time	Stability	Resistance	Extensibility	Energie
<b>Zinc</b>	Zinc oxide	15	=	=	=	=	=	=
		30	=	=	=	=	=	=
		40	=	=	=	=	=	=
		60	=	=	=	=	=	=
		80	=	=	+	+	+	+
		120	=	=	+++	+++	+++	+++

# Increased folic acid amount - Impact on colour?





# Determination of the colour



## Measurement with L\*a\*b\*Colorimeter

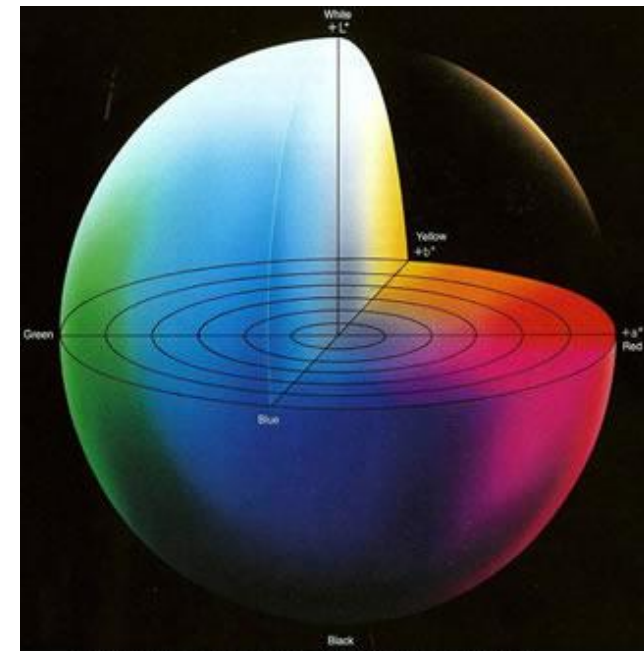
**L**= Lightness (0=black, 100=white)

**a**= position between red (0 to 60) and green (0 to-60)

**b**= position between blue (0 to-60) and yellow (0 to 60)

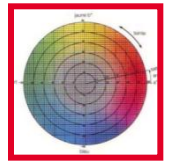
## Comparing the results:

Colour distance	Deviation
$\Delta b_{S0S1} < 0.5$	not visible
$0.5 < \Delta b_{S0S1} < 1.0$	very low
$1.0 < \Delta b_{S0S1} < 3.0$	low
$3.0 < \Delta b_{S0S1} < 6.0$	medium
$6.0 < \Delta b_{S0S1}$	high

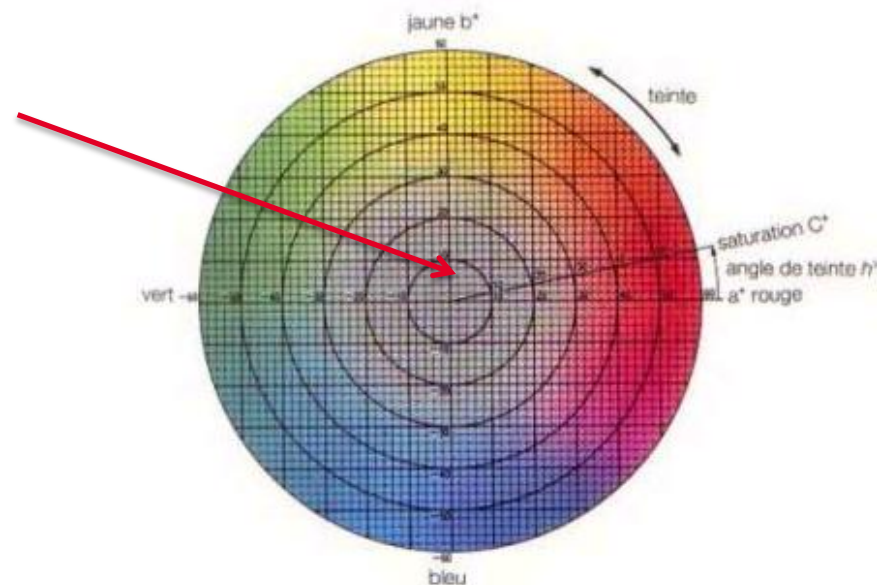


Graphical representation of the L\*a\*b\* colour space model.

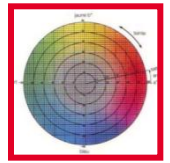
# Increased folic acid amount – Impact on the colour of flour



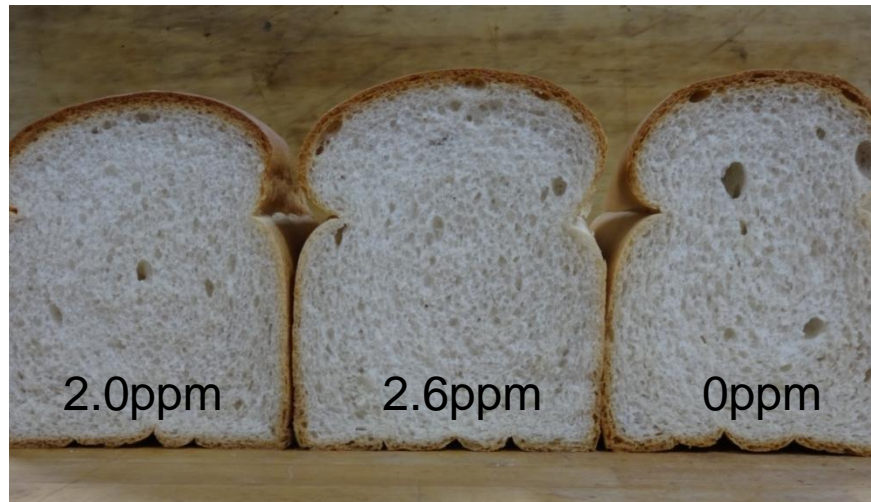
	b*- value	Deviation from non-enriched flour	
<b>Non-enriched flour</b>	<b>+6.15</b>		
<b>Flour with 2 ppm folic acid</b>	<b>+6.24</b>	<b>0.09</b>	<b>not visible</b>
<b>Flour with 2.6 ppm folic acid</b>	<b>+6.28</b>	<b>0.13</b>	<b>not visible</b>



# Increased folic acid amount – Impact on the colour of bread



	b*- value	Deviation from non-enriched bread	
<b>Non-enriched bread</b>	<b>+14.03</b>		
<b>Bread with enriched flour (2 ppm folic acid)</b>	<b>+14.24</b>	<b>0.21</b>	<b>not visible</b>
<b>Bread with enriched flour (2.6 ppm folic acid)</b>	<b>+14.35</b>	<b>0.32</b>	<b>not visible</b>



# Interaction between flour improvers and fortificants



## Bleaching agents

- Example: Malaysia
  - Benzoyl peroxide 50ppm
  - Vitamin premix (B vitamins and iron)
- SGS analysis every year since 2007
- Results always within specification

→ No interaction in flour

**SGS**

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Hamburg, 26.05.2008

Test Report 0820312-1

Sample-No.	081360054 / 1
Product	Flour, Treated with ELCOvit
Sample reference	MC-No: 57816
Sample description	Origin: , Sample date: May 2008
Date of receipt	14.05.08
Testing period (begin / end)	14.05.08 / 26.05.08
Sample Comments	

Test - Method	Unit	Result	Specification
<b>Elements - ICP SOP AAC/MI/317</b>			
Iron	mg/kg	65,1	>42
<b>Niacin - acidimetric (AOAC 944.13)</b>			
Niacin	mg/kg	57,4	>46
<b>Vitamin B1 - HPLC (DIN EN 14122)</b>			
Vitamin B1	mg/kg	5,20	>4,2
<b>Vitamin B2 - HPLC (DIN EN 14152)</b>			
Vitamin B2	mg/kg	8,40	>6,7

SGS Germany GmbH  
Laboratory Services Hamburg

i.V. *S. Rohde*  
Dr. Roy Hömer (Laborleiter) / Ingrid Bujara (Analytical Consultant Food)  
Stephanie Rohde (Analytical Consultant Food) / Jessica Monauri (Analytical Consultant Food)

\*N.A = Not analysed, \*N = Test not accredited, \*S = Test subcontracted, < = less than

Page 1 of 1

The results refer only to the analysed samples. Information about the measurement uncertainties will be given on request.  
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# Interaction between flour improvers and fortificants



## Ascorbic acid

- Case study from Brazil
  - Premix: Ascorbic acid + vitamin mix with iron
  - Discoloration of premix after 1-3 days (30°C/80% r.H.)
  - Reaction between ascorbic acid and iron

1h /30°C/80%



coarse (l.) and fine (r.)  
ascorbic acid with vitamin/iron mix

18h /30°C/80%



coarse (l.) and fine (r.)  
ascorbic acid with vitamin/iron mix

→ Different feeders

Thank you for your attention!