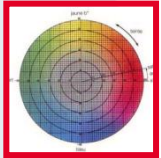


Flour fortification in SEA – addressing technical concerns

4th Annual Southeast Asia District Conference
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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) ¹			
			<75 ² 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 ³	NR ³ 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 ₁₂	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 ³	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%	↑↑

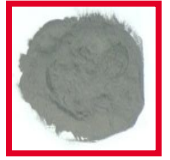
Impact of different iron sources on final products



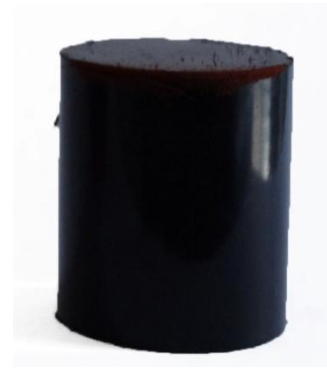
Example: Pasta enrichment

	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

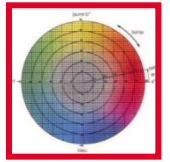


Increased zinc level - Influence on the rheological characteristics

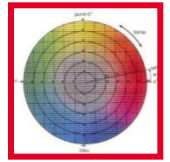
- Example: Wheat flour

Active agent	Raw material	Content of active agent in flour (ppm)	FARINOGRAPH			EXTENSOGRAPH		
			WA	Development time	Stability	Resistance	Extensibility	Energie
Zinc	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

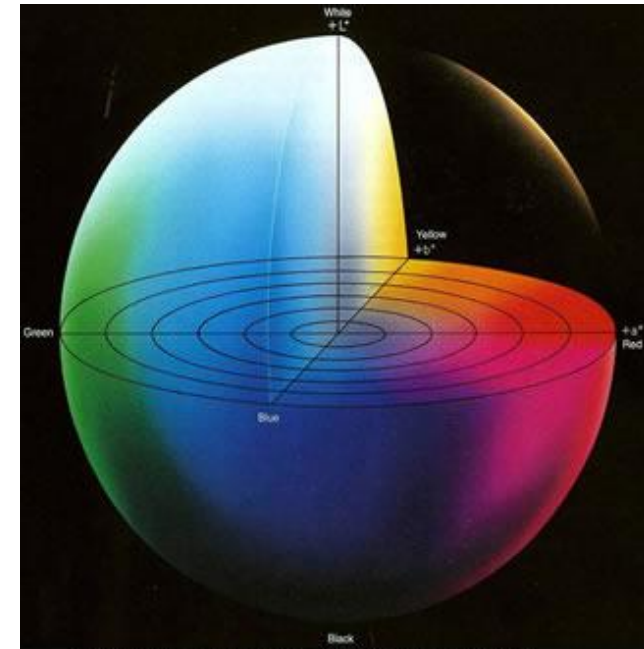
L= Lightness (0=black, 100=white)

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

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

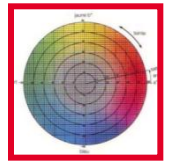
Comparing the results:

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

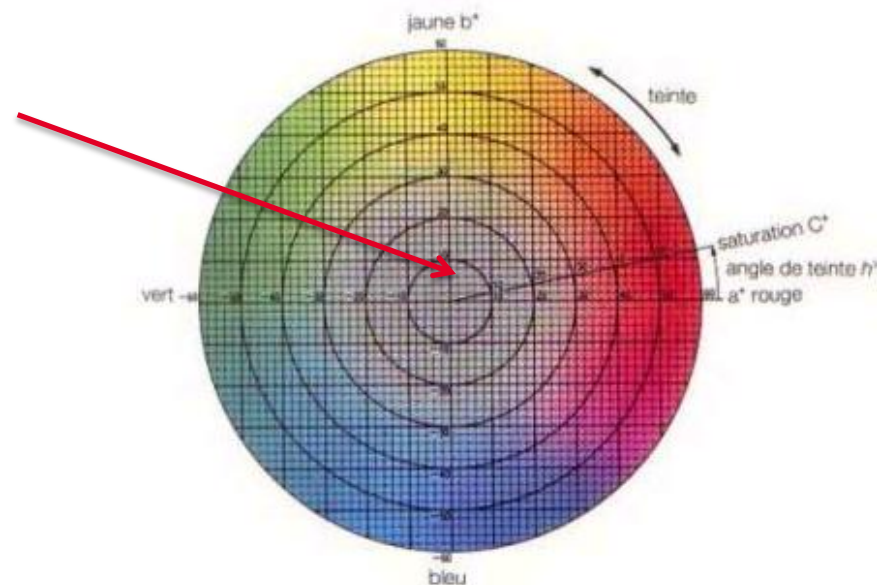


Graphical representation of the L*a*b* colour space model.

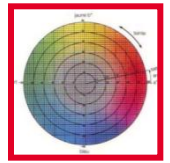
Increased folic acid amount – Impact on the colour of flour



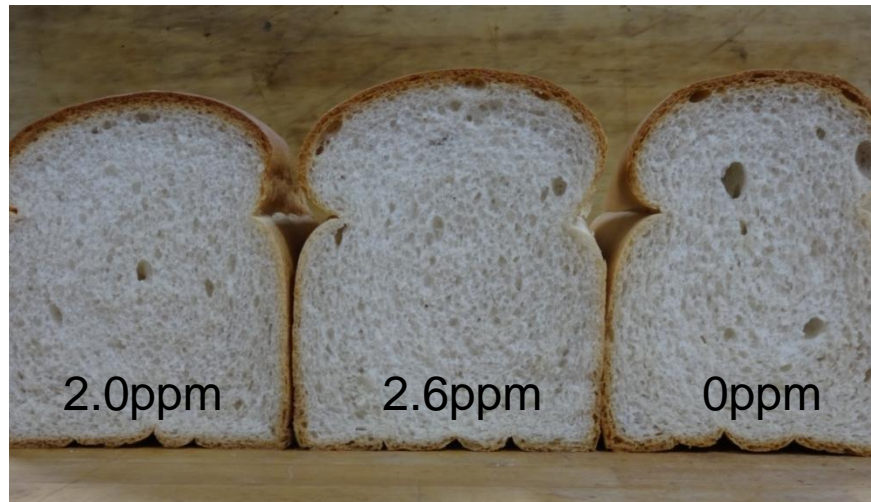
	b*- value	Deviation from non-enriched flour	
Non-enriched flour	+6.15		
Flour with 2 ppm folic acid	+6.24	0.09	not visible
Flour with 2.6 ppm folic acid	+6.28	0.13	not visible



Increased folic acid amount – Impact on the colour of bread



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



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
Elements - ICP SOP AAC/IM/317			
Iron	mg/kg	65,1	>42
Niacin - acidimetric (AOAC 944.13)			
Niacin	mg/kg	57,4	>46
Vitamin B1 - HPLC (DIN EN 14122)			
Vitamin B1	mg/kg	5,20	>4,2
Vitamin B2 - HPLC (DIN EN 14152)			
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!