Physical and Sensory Evaluation of Chapatti and Puri prepared from Fortified Flour

Presentation By

Vikram Kelkar

Director – International Business Development

HEXAGON NUTRITION PVT. LTD.

Outline

A. Motivation
B. Methodology
C. Premix & Flour Evaluation
D. Chapatti & Puri Preparation & Evaluation
E. Conclusions

Motivation

"Success doesn't mean the absence of failures; it means the attainment of ultimate objectives. It means winning the war, not every battle"

– Edwin C. Bliss

Motivation (Contd.)

- *Fortification of Flour in India is a pressing need and a challenge*
- *Pressing Need because of Rampant Malnutrition leading to*
    - *infant mortality*
    - *Premature deaths*
    - *Birth Defects*
- *A Challenge Because of*
    - *Logistics*
    - *Diversity*
    - *Regulations*
    - *Lack of Systematic Approach*

Approach

- Scientific
- Data Based
- Needs to Cover a wide geographical spread

  – This study is a systematic and scientific beginning to address the malnutrition issue in India

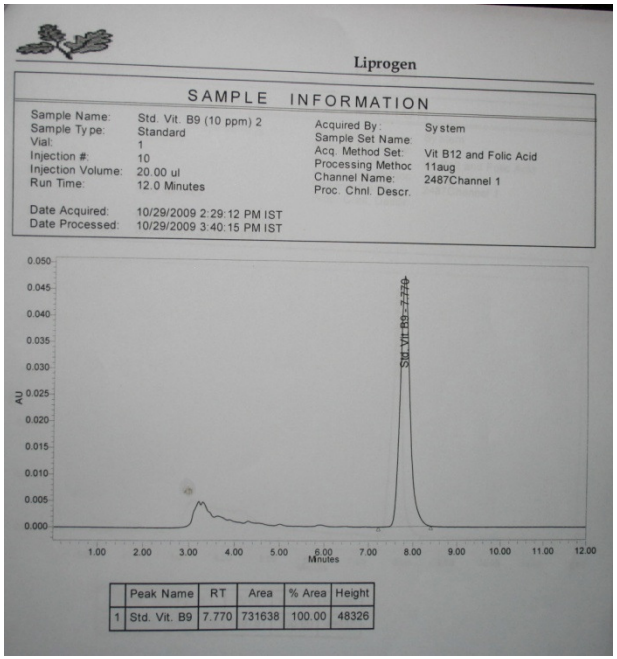
Methodology

- Detailed Experimental Planning
- Good Laboratory Practices for Project Execution
  - Step wise Execution
  - Validated sample preparation methodologies
  - Internationally accepted Analysis & Evaluation Techniques

Methodology (Contd.)

HPLC for Vitamin Analysis

Typical Chromatogram



Evaluation of Premix and Flour

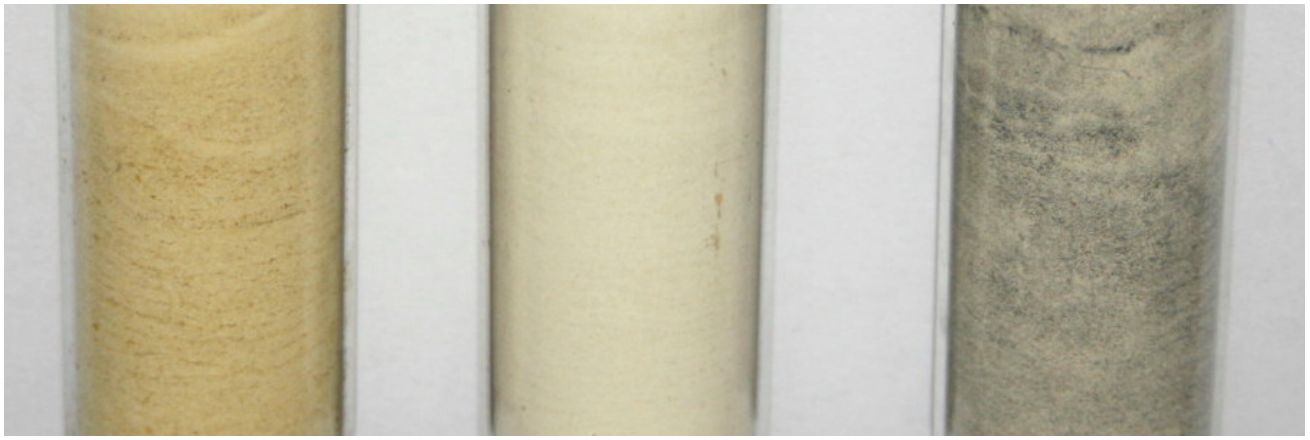
Analysis of Vitamin Premix

Summary of Vitamin Premix Analysis						
Sample	FF-IF-01 (Iron as Ferric Sodium EDTA)		FF-IF-02 (Iron as Ferrous Sulphate)		FF-IF-03 (Iron as Electrolytic Iron)	
Nutrient	Specification	Value	Specification	Value	Specification	Value
	g / 250 g		g / 200 g		g / 150 g	
Vitamin B12	0.010	0.014	0.010	0.016	0.010	0.017
Folic Acid	1.30	1.46	1.30	1.62	1.30	1.59
Iron	20.00	30.25	30.00	42.60	60.00	71.85

Methods of Analysis	
1	British/EU Pharmacopeia for Vitamin analysis
2	Atomic Absorption/Colorimetric Methods for Iron Analysis

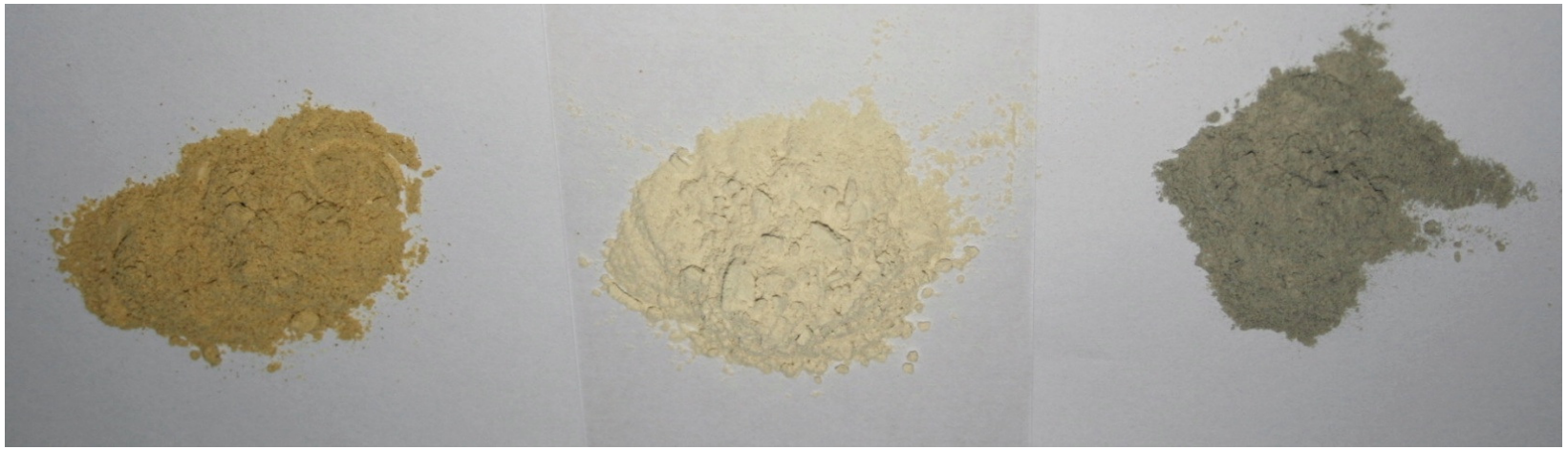
- Various Levels of Vitamin B12, Folic Acid and Iron are present in the premix
- Most of the content confirm with analysis

Visual Appearance of Vitamin Premix



- Nomenclature from Left to Right
  - FORTIVIT – FF – IF – 01 (with Iron as Ferric Sodium EDTA)
  - FORTIVIT – FF – IF – 02 (with Iron as Ferrous Sulphate)
  - FORTIVIT – FF – IF – 03 (with Iron as Electrolytic Iron)
- Significant Differences in Color
  - From Yellow to white to green

Vitamin Premix (Powder)



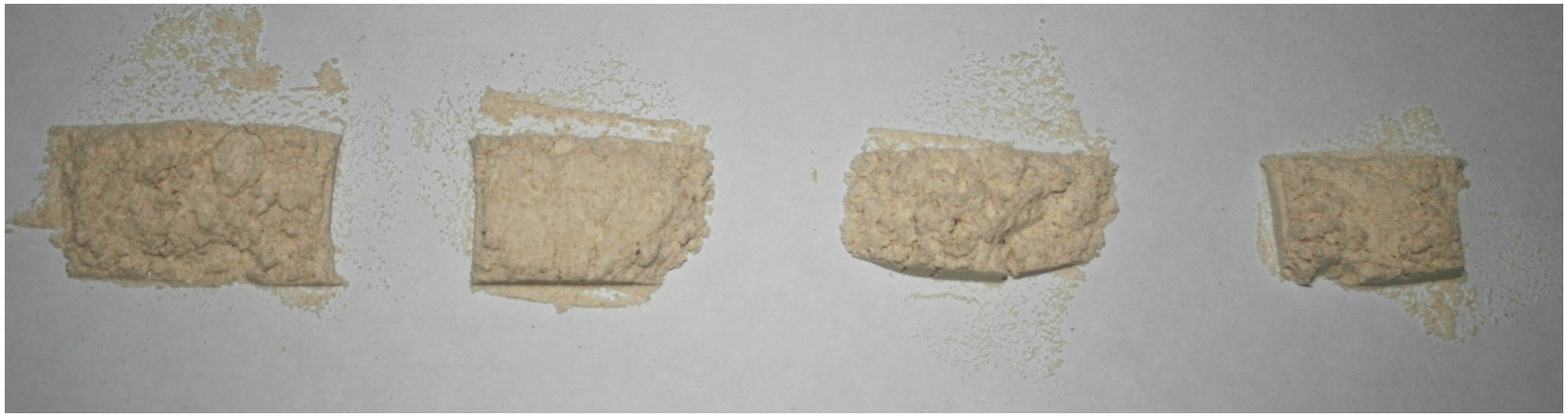
Nomenclature from Left to Right:

- FORTIVIT-FF-IF-01 (with Iron As Ferric Sodium EDTA)
- FORTIVIT-FF-IF-02 (with Iron as Ferrous Sulphate)
- FORTIVIT-FF-IF-03 (with Iron as Electrolytic Iron Powder)

Visual Appearance of Fortified and Unfortified Flour

- Nomenclature Left to Right
- Control Sample (Without Fortification)
- Flour Fortified with FORTIVIT- FF-IF-01 (Iron as Ferric Sodium EDTA)
- Flour Fortified with FORTIVIT- FF-IF-02 (Iron as Ferrous Sulphate)
- Flour Fortified with FORTIVIT- FF-IF-03 (Iron as Electrolytic Iron)
- No appreciable difference in Flour Colour

Visual Appearance of Fortified and Unfortified Flour



- Nomenclature Left to Right
- Control Sample (Without Fortification)
- Flour Fortified with FORTIVIT- FF-IF-01 (with Iron as Ferric Sodium EDTA)
- Flour Fortified with FORTIVIT- FF-IF-02 (with Iron as Ferrous Sulphate)
- Flour Fortified with FORTIVIT- FF-IF-03 (with Iron as Electrolytic Iron)
- No appreciable difference

Proximate Analysis of Flour

	Parameter	Ref. Value*	Value
		Wt. %	
A	Moisture	12.2	9.8
B	Total Protein	12.1	9.5
C	Total Fats	1.7	2.4
D	Total Carbohydrate	69.4	76.9
E	Total Ash		1.4

*	Nutritive Value of Indian Foods C. Gopalan et al National Institute of Nutrition ICMR, Hyderabad

Summary

- Premixes differ significantly in colour from Yellow Brown to Beige to Green depending on type of Iron used
- Composition of nutrients is as claimed in specification with overages
- The color of Fortified flour with different premixes is similar to the control flour (Unfortified)
- All Samples are supplied by Hexagon Nutrition Pvt. Ltd. (India)

Evaluation Chapattis & Puris

Preparation of Chapattis

- Prepared according to the method employed in Western India
  - Characterized by thin, typically prepared without oil
- Manual preparation of dough
- Manual rolling & roasting of Chapattis
- Chapattis made within ½ hr preparation of dough
- Chapatti Content:
  - Flour, Water and Salt (8.8 g, 7.0 g, 0.2 g – Avg. content per chapatti before roasting)
  - Roasted on a pan fired by Compressed Natural Gas
  - Evaluated within 4 hrs of preparation

Physical Evaluation of Chapattis

Analysis of Chappatis	Control		Fortified with					
			FORTIVIT-FF-IF-01 (Iron as Ferric Sodium EDTA)		FORTIVIT-FF-IF-02 (Iron as Ferrous Sulphate)		FORTIVIT-FF-IF-03 (Iron as Electrolytic Iron)	
Size	Dia - cm	Wt. - g	Dia - cm	Wt. - g	Dia - cm	Wt. - g	Dia - cm	Wt. - g
Average	12.2	9.414	12.5	9.764	12.3	11.036	11.9	9.411
Std. Err.	0.1	0.211	0.2	0.268	0.2	0.288	0.1	0.292
Sample	14		14		14		14	
Ratio Wt/dia - g/cm	0.775		0.780		0.896		0.794	
Moisture - Wt. %	22.03		19.44		23.64		20.75	

Evaluation of Chapattis (Contd.)

- Size and weights are comparable for control, Chapatti with FORTIVIT-FF-IF-01(with Iron as Ferric Sodium EDTA) and Chapatti with FORTIVIT-FF-IF-03 (with Iron as Electrolytic Iron)

- Chapattis made from FORTIVIT-FF-IF-02 (with Iron as Ferrous Sulphate) are more dense

- Moisture is most retained by Chapatti with FORTIVIT-FF-IF-02, followed by Control followed by Chapatti with FORTIVIT-FF-IF-01 and Chapatti with FORTIVIT- FF-IF-03

- Nutrients added are retained after preparation of chapattis.

Visual Evaluation of Chapattis

Nomenclature from Left to Right:

- Control, Chapatti with FORTIVIT FF-IF-01, Chapatti with FORTIVIT FF-IF-02, Chapatti with FORTIVIT FF-IF-03
- Color of Chapattis made from Fortified Atta are slightly darker than the control
- No holes observed upon roasting
- No cracking observed upon roasting
- No spots observed particular to fortified flour

Chapatti Making Process

Dough

Rolling

Roasting

Final Touches

Sensory Evaluation of Chapattis

- 7 member panel
- Untrained
- Tested for Taste and Chew ability
- Ranked for overall attributes
- Evaluated on 5 point Hedonic scale

Sensory Evaluation Sheet

SENSORY EVALUATION - TASTE						
CHAPPATI						
	Dilike Very Much	Dislike	Niether Like or Dislike	Like	Like Very Much	Comment
Score	1	2	3	4	5	
Sample A						
B						
C						
D						

RANK ANALYSIS				
SAMPLE	A	B	C	D
RANK				

- Same format used for sensory evaluation of Puris

Sensory Evaluation of Chapattis

No.	Chappatis - Sensory Evalution							
	Control		FF-IF-01		FF-IF-02		FF-IF-03	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
1	3	3	4	1	2	4	3	2
2	3	3	3	1	1	4	3	2
3	2	4	4	1	3	3	3	2
4	2	4	2	2	2	3	3	1
5	4	1	2	3	3	2	3	2
6	3	2	2	3	2	4	4	1
7	2	4	3	1	3	2	2	3
Avg.	2.7	3.0	2.9	1.7	2.3	3.1	3.0	1.9
Std. Error.	0.3	0.4	0.3	0.4	0.3	0.3	0.2	0.3

Sensory Evaluation (Cont.)

- Chapatti Fortified with FORTIVIT-FF-IF-03 (with Iron as Electrolytic Iron Powder) is the most preferred in taste and chew ability
- Chapatti Fortified with FORTIVIT FF-IF-01 (with Iron as Ferric Sodium EDTA) is most preferred in overall rank
- Chapatti Fortified with FORTIVIT FF-IF-02 (with Iron as Ferrous Sulphate) is least preferred in taste and chew ability and overall rank
- Chapatti Fortified with FORTIVIT FF-IF-01 & FORTIVIT-FF-IF-03 are preferred over the control in taste/chew ability and overall rank

Preparation of Puris

- Prepared according to the method employed in Western India
- Manual preparation of dough
- Manual rolling & frying puris
- Puris made within ½ hr preparation of dough
- Puris Content:
  - Flour, Water and Salt (8.4 g, 3.4 g, 0.2 g – Avg. content per puri before frying)
  - Deep Fried in Rice Bran/Safflower Oil – Saffola Gold Brand – Lot No. RR030-G
  - Evaluated within 4 hrs of preparation

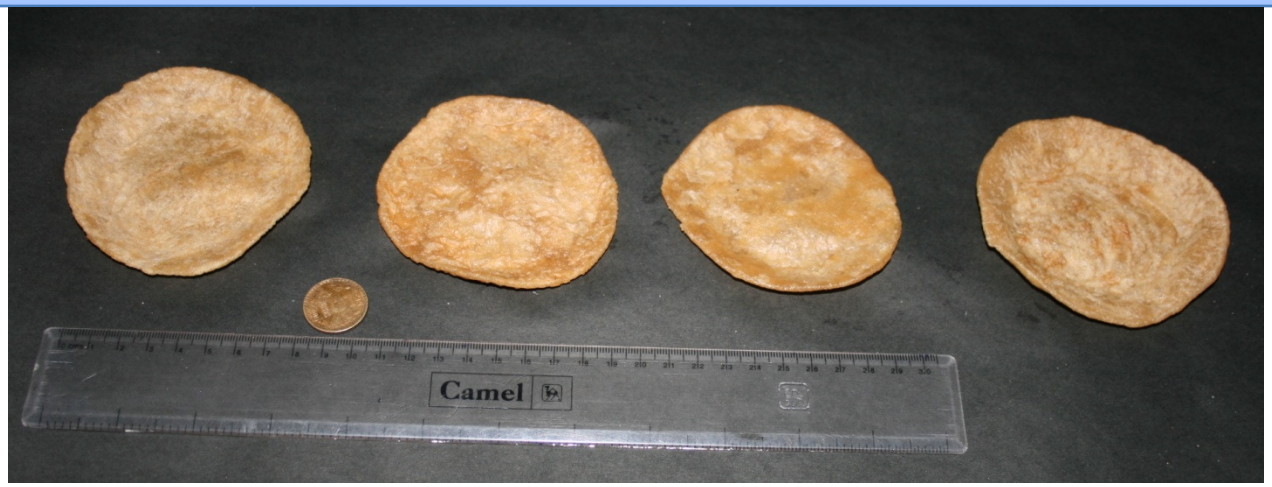
Physical Evaluation of Puris

Analysis of Puris	Control		Fortified with					
			FORTIVIT- FF-IF-01 (Iron as Ferric Sodium EDTA)		FORTIVIT-FF-IF-02 (Iron as Ferrous Sulphate)		FORTIVIT-FF-IF-03 (Iron as Electrolytic Iron Powder)	
Size	Dia - cm	Wt. - g	Dia - cm	Wt. - g	Dia - cm	Wt. - g	Dia - cm	Wt. - g
Average	10.2	13.803	9.6	15.453	9.4	14.287	9.8	15.133
Std. Err.	0.2	0.412	0.1	0.449	0.1	0.304	0.1	0.298
Sample	14		15		15		15	
Ratio Wt/dia - g/cm	1.358		1.603		1.521		1.548	
Oil Content - Wt. %	25.63		32.85		16.93		25.08	
Ratio (Oil Free basis) Wt/dia - g/cm	1.010		1.076		1.264		1.160	

Evaluation of Puris (Contd.)

- Dimensions and Weights of Puris are comparable
- Puris prepared from fortified flour are more dense
- Oil retained by Puri With FORTIVIT-FF-IF-02 is *significantly* less than others
- All micro nutrients are present after deep frying of Puris

Visual Evaluation of Puris



Nomenclature from Left to Right:

- Control, Puri with FORTIVIT-FF-IF-01 (with Iron as Ferric Sodium EDTA), Puri with FORTIVIT- FF-IF-02 (with Iron as Ferrous Sulphate), Puri with FORTIVIT- FF-IF-03 (with Iron as Electrolytic Iron)
- Puris made from fortified Atta are slightly darker than the control
- No holes or cracks observed in Puris upon frying
- No spots observed particular to fortified flour

Sensory Evaluation of Puris

- 7 member panel
- Untrained
- Tested for Taste and Chew ability
- Ranked for overall attributes
- Evaluated on 5 point Hedonic scale

Sensory Evaluation (Contd.)

No.	Puri - Sensory Evaluation							
	Control		FF-IF-01		FF-IF-02		FF-IF-03	
	Score	Rank	Score	Rank	Score	Rank	Score	Rank
1	3	3	5	1	4	4	5	2
2	3	2	4	4	5	1	4	3
3	3	4	4	2	4	3	5	1
4	2	4	4	3	4	1	4	2
5	2	4	4	2	5	1	3	3
6	4	1	3	4	3	3	4	2
7	3	4	4	2	4	1	4	3
Avg.	2.9	3.1	4.0	2.6	4.1	2.0	4.1	2.3
Std. Error	0.3	0.5	0.2	0.4	0.3	0.5	0.3	0.3

Sensory Evaluation(Contd.)

- Puri with FORTIVIT-FF-IF-02 (with Iron as Ferrous Sulphate) & FORTIVIT-FF-IF-03 (with Iron as Electrolytic Iron) are comparable in taste & chew ability and preferred over control and marginally over Puri with FORTIVIT-FF-IF-01(with Iron as Ferric Sodium EDTA)

- Puri with FORTIVIT-FF-IF-02 (with Iron as Ferrous Sulphate) is most preferred in overall rank

- Control is least preferred in taste and chew ability and overall rank

- Puri with FORTIVIT- FF-IF-01, Puri with FORTIVIT- FF-IF-02 & Puri with FORTIVIT- FF-IF-03 are preferred over the control in Taste/Chew ability and overall rank

- *Less oil content of FF-IF-02 puris does not seem to affect the taste and chew ability compared to puris prepared from other fortified and control flour*

Conclusions

In Conclusion

- Vitamin Premixes differ significantly in color
- Fortified Flour is very similar in color to the control sample
- For Chapattis:
  - Micronutrients are retained after the preparation of chapattis
  - Fortification of Flour does not induce any negative effect on texture of chapattis compared to control
  - Fortification of Flour with FORTIVIT-FF-IF-01 and FORTIVIT-FF-IF-03 has no negative effect on taste, appearance and overall acceptability of chapattis compared to the control
  - FORTIVIT-FF-IF-03 Fortified chapattis are preferred overall compared to others including control
- For Puris:
  - Micronutrients are retained after the preparation of puris
  - Fortification of Flour does not induce any negative effect on texture of puris compared to control
  - Fortification of Flour with FORTIVIT-FF-IF-01, FORTIVIT-FF-IF-02 & FORTIVIT-FF-IF-03 has no negative effect on taste, appearance and overall acceptability of puris compared to the control
  - Flour Fortified with FORTIVIT-FF-IF-02 absorbs less oil compared to control and others.

THANK YOU