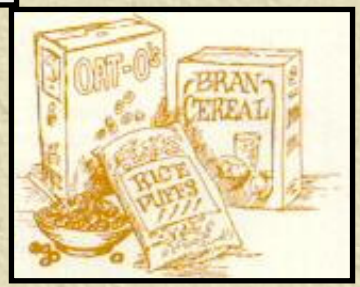
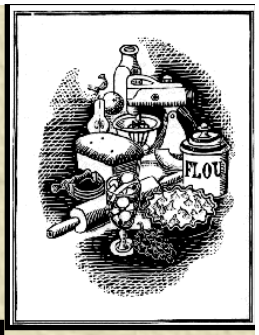




"DEVELOPMENT OF MILLET BASED LOW GLYCEMIC COMPOSITE FLOUR FOR DIABETIC PATIENTS"

Dr.Ankita Sharma

Lecturer of Home Science

MITS University,MIER

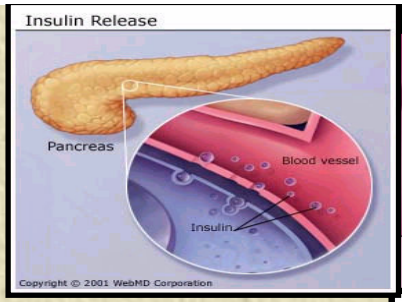
Laxhmangarh-SIKAR

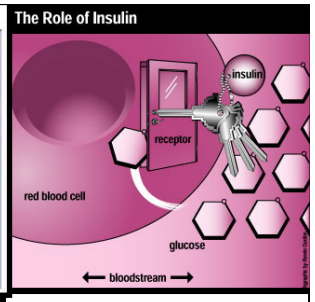
Dr.Maya Choudhry

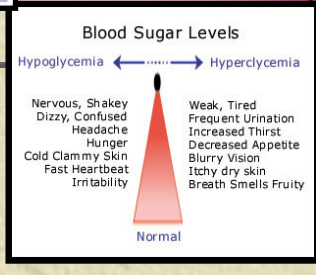
Prof. and Dean, College of Home Science

Maharana Pratap University of Agriculture and Technology

UDAIPUR-Rajasthan

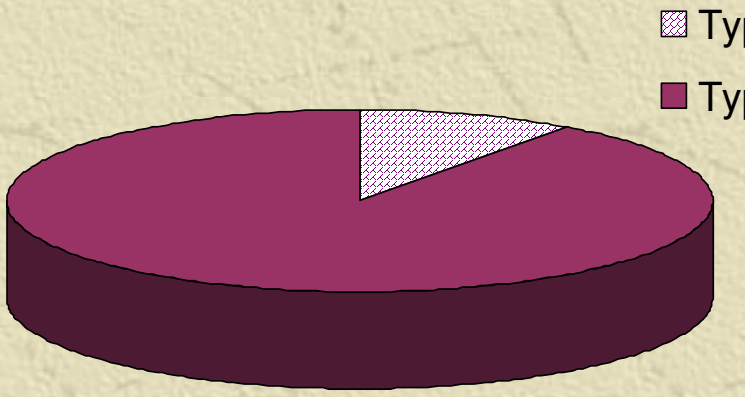


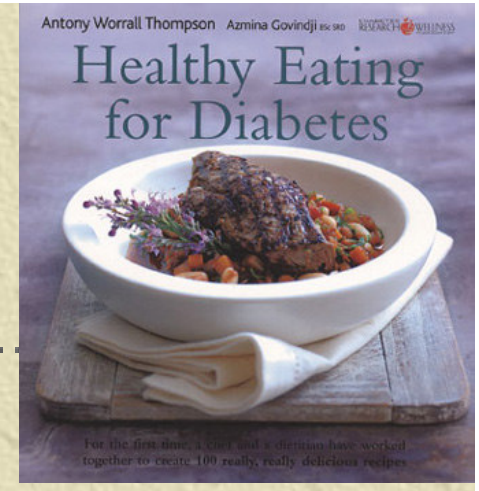




INTRODUCTION

- **Diabetes is a metabolic disorder of multiple aetiology characteristics by chronic hyperglycemia, and associated with impaired carbohydrate, protein and fat metabolism (Parillo etal, 2004).**
- **Inadequate insulin sercetion or impaired insulin action or both.**
- **International diabetic federation (2003) projected that in 1985 135 million people had diabetes and it is expected to rise to almost 333 million by the year 2025.**
- **Out of these majority (40 million) of diabetics are residing in Indian.**





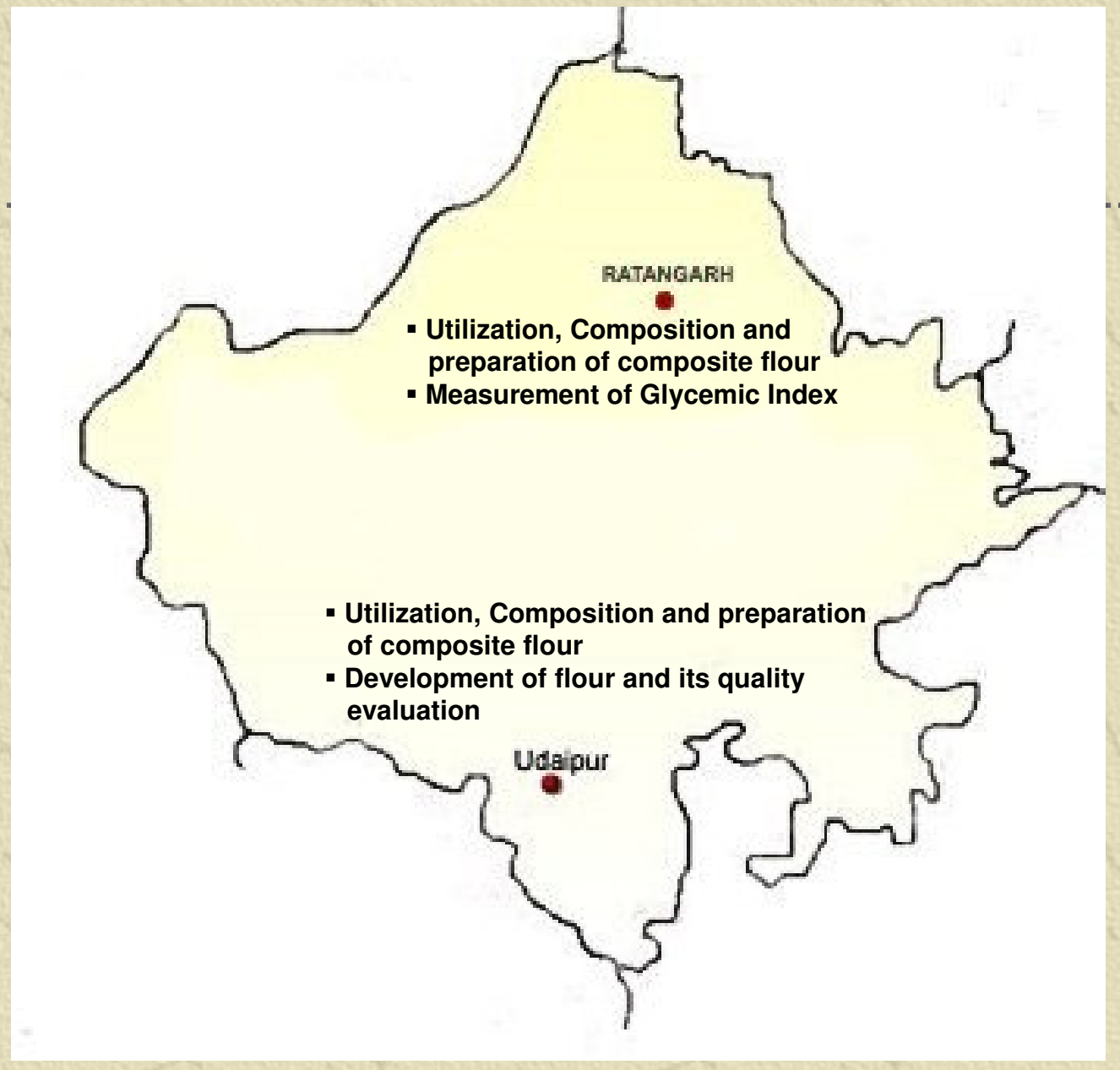
- **Diet is the cornerstone in the management of the disease.**
- **American diabetic association (1998) recommended low fat, low cholestrol and low GI diet.**
  - **Glycemic Index is measured as the blood glucose response to carbohydrate present in a given food as compared to that of carbohydrate in reference food (Khanna, 1997).**
  - **High GI should be replaced from low GI.**

OBJECTIVES

- To find out the utilization of composite flour by diabetics.
- To develop low glycemic composite flour based on commonly consumed millets in Rajasthan.
- To find out the nutrient composition and shelf life of developed composite flour.
- To assess the sensory qualities of *Missi Roti* prepared from developed flours and stored.
- To assess the nutritional status of selected subjects.
- To assess the glycemic index of developed composite flour.

METHODOLOGY

LOCALE



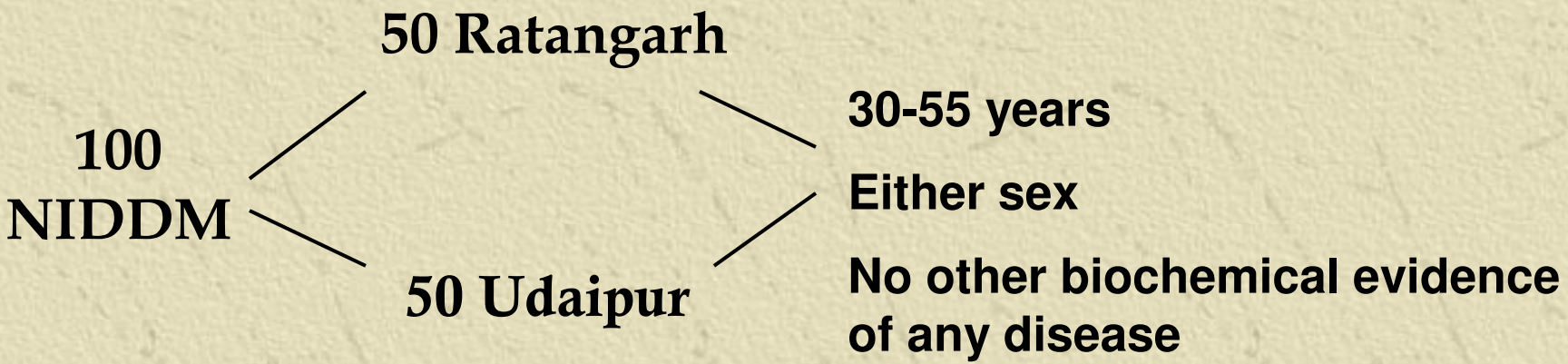
Period of study :- August 2003 to July 2004

STUDY DESIGN

Development and quality evaluation of the low glycemic composite flour

I	II	III	IV
Utilization composition and preparationof composite flour	Development of flour and standardization of *missi roti*	Quality evaluation of the composite flour	Blood glucose response of composite flour

Consumption practices of composite flour among diabetic patient



Development of Flour and Standardization of Missi Roti

Millets — *Composite Flour*

Bajra (BJ)

Maize (MZ)

Foxtail (FT)

+

Bengalgram (BG)

Bengalgram + Barley (BG+BY)

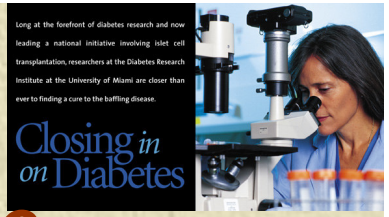
BJ
BJ+BG
BJ+BG+BY

MZ
MZ+BG
MZ+BG+BY

FT
FT+BG
FT+BG+BY

Standardization of *missi roti* for-

1. 40 g. carbohydrate/serving
2. Acceptable



Quality Evaluation of the Composite Flour

Physical characteristic

- Particle size (Henderson 1976 , Sathe 1992)
- Water absorption
- Gluten (Sathe 1992 , Mathewetal 1991)

Nutrient composition

- Proximate principle (NIN, 2004)
- Minerals
  - Zn, Fe, Mo, Cu, Mn, Co (Atomic absorption)
  - Ca, P (Cheng et al. 1951, USDA 1954)
  - Mg, Cr, Mo Na, S, Cl (Gopalan et al, 2004)
- Vitamins (Gopalan et al, 2004)
- Energy

Keeping Quality →

- Moisture (NIN, 2004)
- Rancidity
  - Acid value (NIN, 2004)
  - Peroxide value (Jacob, 1958)
  - Alcoholic acidity (ISI, 1981)
- Insect infestation (Hill, 1990)

Sensory evaluation → Panel of Judges

Shelf life of composite flour

Packaging → **Packed in 1 Kg bags for a period of three months**

Storage → **Sensory evaluation and keeping quality parameters at every one month**

Blood glucose response of composite flour

Selection of subject

A. Age range of 30-55 years

B. Either sex

C. Not suffering with diabetes from atleast six months but for not more than 3 years.

D. No other biochemical evidence of any disease.

E. Controlled diabetes with diet and exercise only.

F. A,B,D for non diabetic.

Nutrition & Health profile of the subjects

Anthropometric measurements

Weight

Height

→ Indices

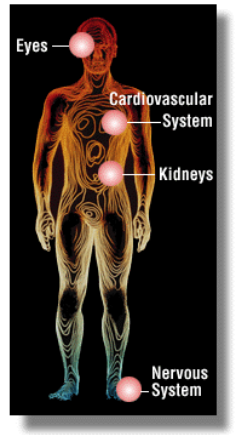
- BMI
- Weight %
- Height %
- Weight for height

Skinfold thickness

Waist circumference

Hip circumference

→ Waist hip ratio



Body Composition

Body fat

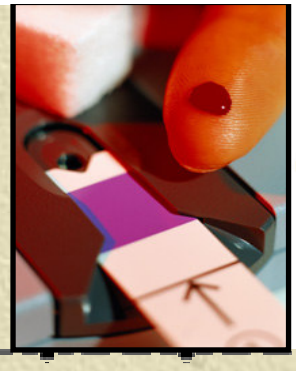
Fatfree mass ⟶ Durnin and Womersley (1974)

Body water ⟶ Siri (1961)

Health habits — Smoking, drinking alcohol, chewing tobacco and exercise.

Food Habits — Food preferred/avoided

Glycemic index of missi roti



Oral glucose Tolerance test

40 g. glucose/100ml

Blood glucose before feeding and at 0, ½, 1, 1½ and 2 hour of feeding.

Test recipe was fed to assess GI of recipe

Statistical Analysis

Mean ± SE

Percentage

“F” Test for significance

RESULTS

Utilization, composition and preparation of composite flour

Table :-1 : Consumption, composition and preparation of composite flour

Details	Diabetics (%)		
	Ratangarh (n=50)	Udaipur (n=50)	Total (n=100)
Consuming composite flour	100	34	67
daily	64	56	60
Weekly/fortnightly/monthly	36	44	40
Duration of consumption (years)			
< 5	68	8	38
5-10	30	18	24
>10	2	8	5
Advised by			
Doctors	96	54	75
Friends	60	82	71
Mass media	34	48	41
Others	2	14	8
Reasons to consume			
Controls blood glucose	96	84	90
Nutritious/beneficial for health	50	50	50
Family tradition/tasty	4	32	18

Details	Diabetics (%)		
	Ratangarh (n=50)	Udaipur (n=50)	Total (n=100)
Composition			
WT+BG	32	8	20
1:1	8	0	4
3:7	10	4	7
3:2	4	8	6
Others			
WT+BG+BY			
1:1:1	30	44	37
1:½:½	0	8	4
Others	16	26	21
WT+BG+BY+SN	0	2	1
Mode of Preparation			
Mixed before grinding/Mixed after grinding	88	82	85
Mixed by the milller	12	10	11
Purchasing readymade from market	0	2	1
Composition advised by			
Doctors	20	10	15
printed material	40	50	45
Friends	40	24	34
Famivzly tradition	0	16	8

WT = Wheat BG=Bengalgram BY= Barley SN=Soyabean

Table :-2 : Common menu of diabetics

Food consumed in different meals	Percentage		
	Ratangarh (n=50)	Udaipur (n=50)	Total (n=100)
Breakfast#			
Tea only	62	48	55
Snacks with or without tea	16	14	15
Lunch			
Chapati + veg + dhal	14	28	21
Chapati + veg + salad	26	24	25
Chapati with veg/dhal and salad Curd butter milk etc.	60	48	54
Evening Tea			
Tea	86	96	91
Juice/fruit	12	2	7
Dinner			
Chapati with vegetable	18	20	19
Chapati with dhal	28	36	32
Chapati + veg + dhal	42	20	31
Chapati with veg/dhal and salad/curd/butter milk	12	24	18

Remaing were taking hypoglycemic foods at the time of breakfast

Table :-3 : Food preferred and avoided due to diabetes

Name of the food	Preferred (%)			Name of the food	Avoided (%)		
	Ratangarh (n=50)	Udaipur (n=50)	Total (n=100)		Ratangarh (n=50)	Udaipur (n=50)	Total (n=100)
Green leafy vegetable	40	2	21	Potato & rice	100	100	100
Fenugreak leaves and Bittergourd	4	44	24	Sweet fruits & sugar	100	100	100
Sangri Aloevera & mint	20	0	11	Fat dry fruits and colocasia	50	74	62
Bitter gourd Jamun & fenugreak leaves	0	16	8				
Other foods	36	40	38				

Development of flour and standardization of *missi roti*

Table :-4 : Composition and cost of composite flour for *missi roti*

S.No.	Name of the cereal/ millet/pulse	Abbrevation	Per 100 g of flour	Rs/Kg
1	Bajara	BJ	100	5.00
2.	Bajra + Bengal gram	BJ + BG	60:40	11.60
3.	Bajra + Bengal gram + Barley	BJ + BG + BY	60:20:20	8.65
4.	Maize	MZ	100	4.00
5.	Maize + Bengal gram	MZ + BG	60:40	11.26
6.	Maize + Bengal gram + Barley	MZ BG + BY	60:20:20	8.31
7.	Foxtail	FT	100	15.00
8.	Foxtail + Bengal gram	FT + BG	60:40	23.60
9.	Foxtail + Bengal gram + Barley	FT + BG + BY	60:20:20	20.65

Table :-5 : Ingredients used for one serving of *missi roti*

S.No.	Flour	g/serving	Water (ml)	Dough wt. (g)	Oil (g)
1	BJ	57.6	67.3	91.7	2.1
2.	BJ + BG	59.9	**67.6**	84.7	2.1
3.	BJ + BG + BY	58.3	**67.6**	84.1	**1.0**
4.	MZ	58.7	60.0	**106.4**	2.5
5.	MZ + BG	60.6	**47.0**	104.7	2.4
6.	MZ BG + BY	59.0	47.6	105.1	**2.7**
7.	FT	**63.8**	52.1	**7.8**	2.2
8.	FT + BG	**63.8**	49.8	76.3	2.1
9.	FT + BG + BY	62.0	51.6	76.5	2.3

Quality evaluation of the composite flour

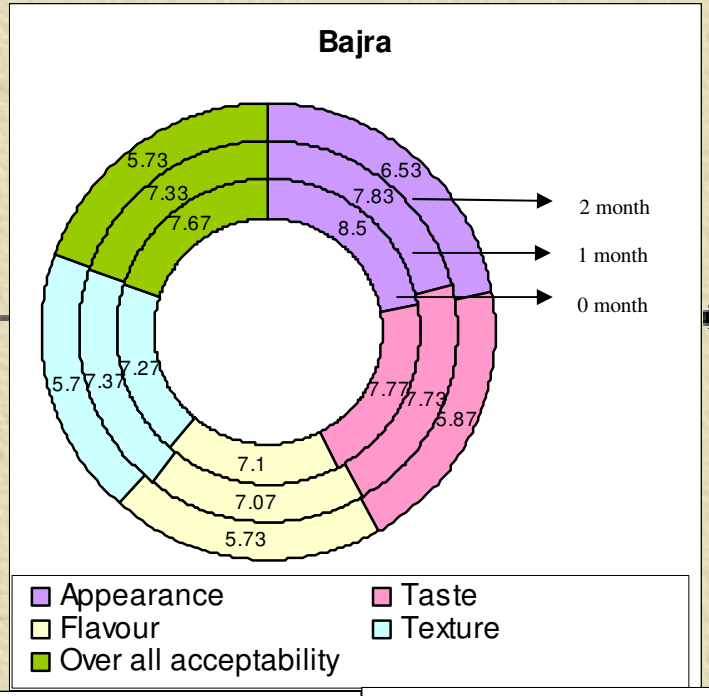
Table :-6 : Nutrient composition of composite flour (g/100 g)

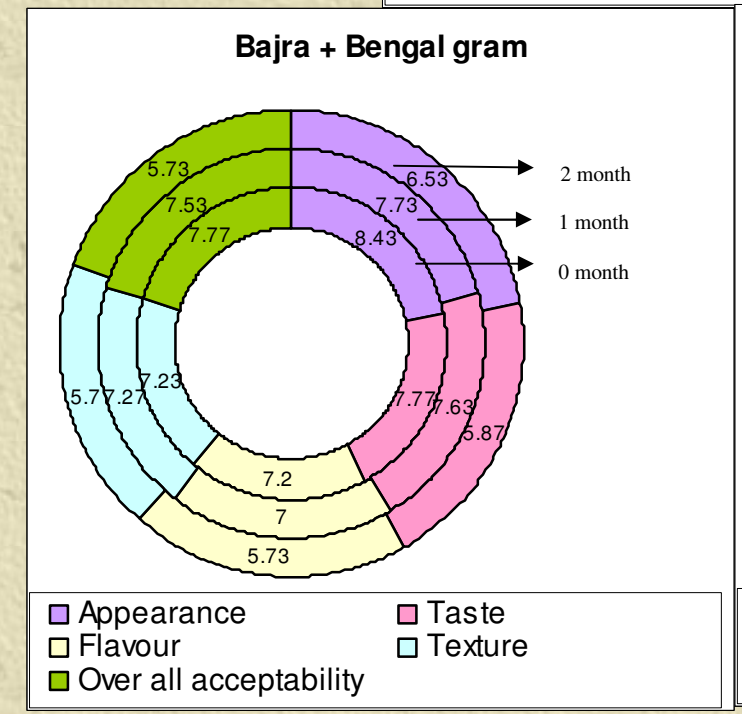
S. No.	Flour	Moisture	Protein	Fat	Ash	Fibre	Carbohy -drate	Energy (Kcal)
1.	BJ	11.33	**6.43**	3.14	0.980	1.00	77.12	362
2.	BJ + BG	**12.10**	15.53	2.96	1.07	2.14	66.62	**315**
3.	BJ+BG+BY	10.79	12.65	2.51	0.977	2.10	70.97	357
4.	MZ	**7.96**	10.19	0.96	0.980	2.10	**77.81**	360
5	MZ + BG	8.69	15.73	1.11	1.219	2.90	70.35	355
6.	MZ+BG+BY	9.08	12.63	**1.08**	**0.918**	3.00	73.23	353
7.	FT	8.94	13.09	**3.61**	1.046	**6.50**	66.81	352
8.	FT + BG	8.36	17.51	2.44	**2.42**	6.00	63.27	345
9	FT+BG+BY	8.84	13.13	1.10	**2.42**	6.10	68.41	336

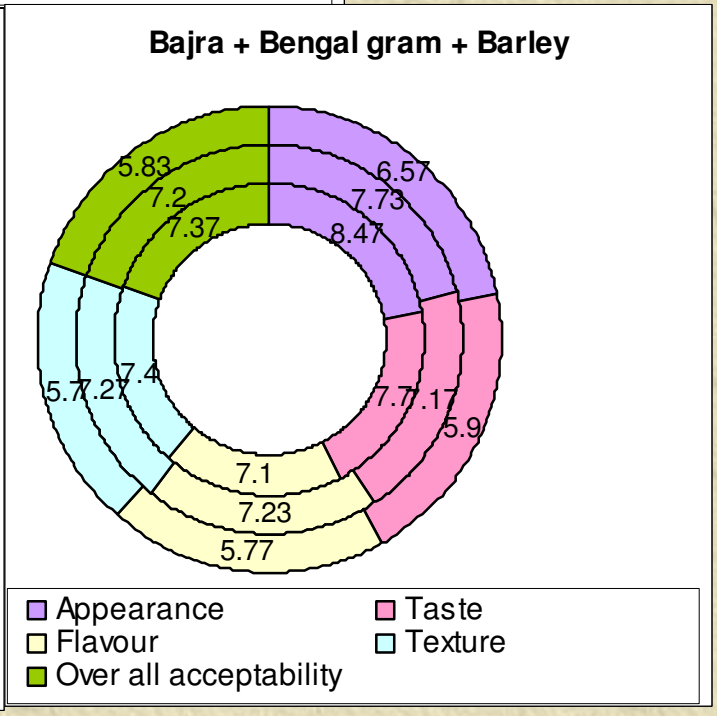
Table :-7 : Mineral composition of composite flour

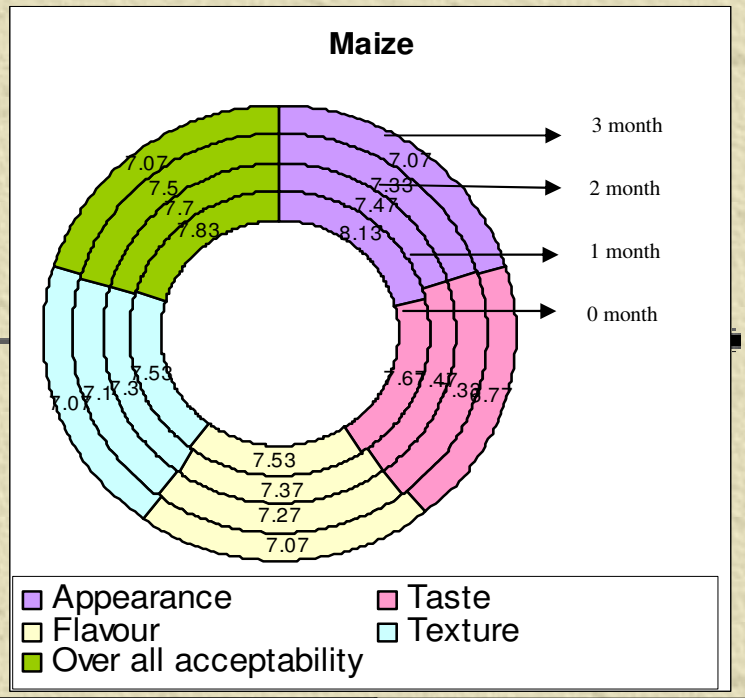
S. No.	Flour	Mg/100 g (dry weight basis)						
		Ca	P	Zn	Co	Cu	Fe	Mn
1	BJ	21.0	220	6.20	ND	0.39	**4.60**	1.10
2.	BJ + BG	30.0	248	5.70	ND	0.80	4.90	1.10
3.	BJ+BG+BY	31.0	250	8.60	**0.30**	0.80	4.80	0.70
4.	MZ	**19.0**	290	11.10	**0.60**	**0.50**	6.50	**0.50**
5.	MZ + BG	26.0	300	5.60	0.50	1.00	6.90	0.90
6.	MZ+BG+BY	29.0	300	10.20	ND	0.60	8.60	1.10
7.	FT	28.0	**320**	**14.30**	ND	1.00	8.90	**5.10**
8.	FT + BG	38.0	310	13.30	0.40	**1.30**	7.90	3.30
9.	FT+BG+BY	28.0	**320**	10.70	ND	1.00	9.30	1.80

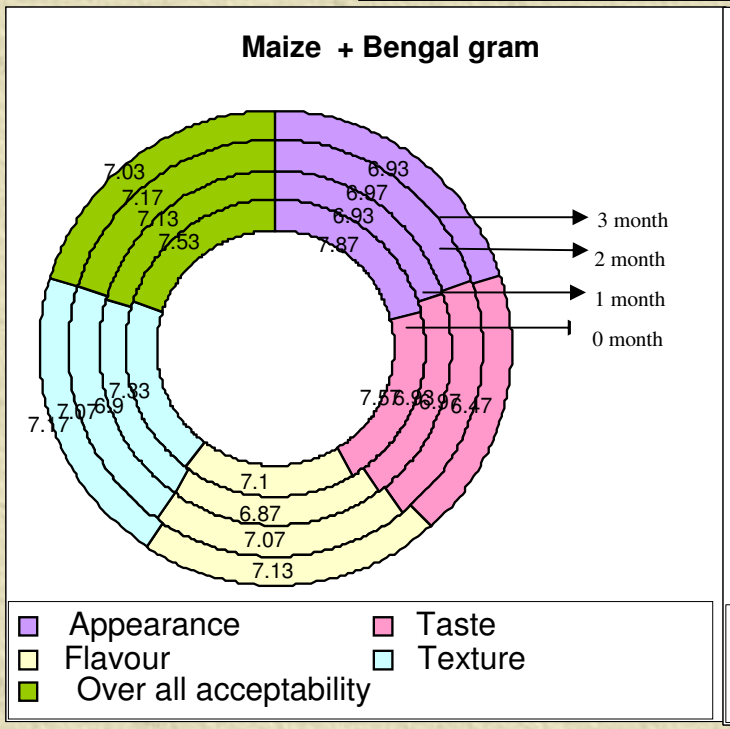
Acceptability scores of Missi Roti

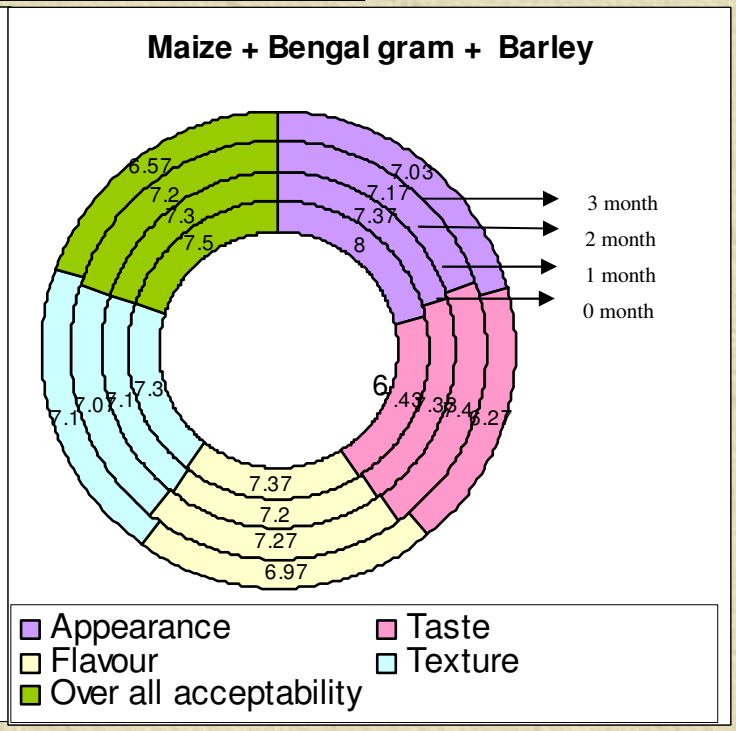

Bajra
6.53
7.83
8.5
5.73
7.33
7.67
2 month
1 month
0 month
7.77
7.73
5.87
7.1
7.07
5.73
5.77
7.37
7.27
Appearance
Taste
Flavour
Texture
Over all acceptability

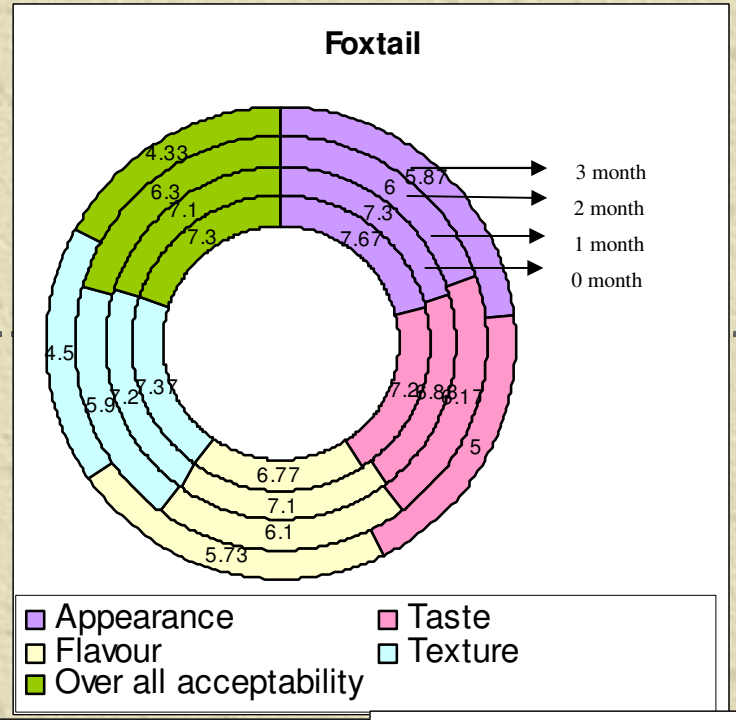

Bajra + Bengal gram
6.53
7.73
8.43
5.73
7.53
7.77
2 month
1 month
0 month
7.77
7.63
5.87
7.2
7
5.73
5.77
7.27
7.23
Appearance
Taste
Flavour
Texture
Over all acceptability

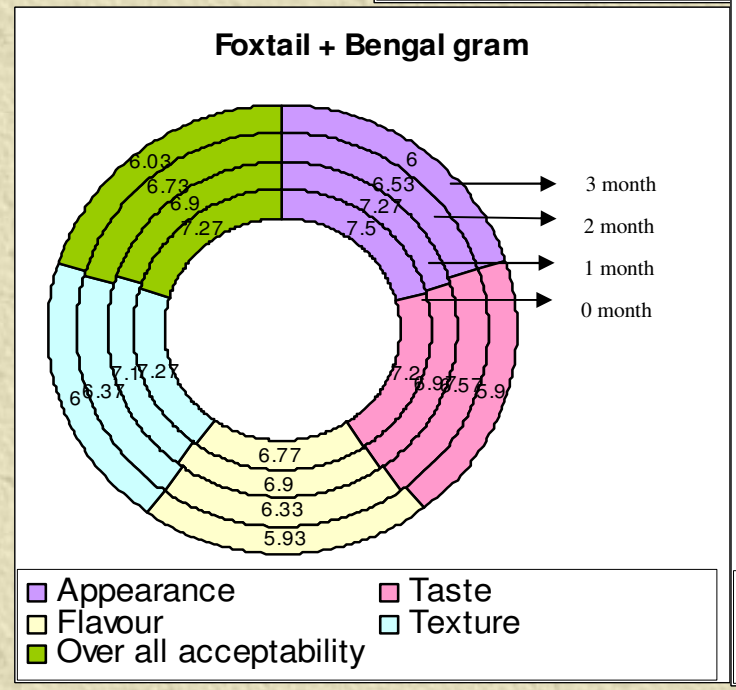

Bajra + Bengal gram + Barley
6.57
7.73
8.47
5.83
7.2
7.37
7.77
7.17
5.9
7.1
7.23
5.77
5.77
7.27
7.4
Appearance
Taste
Flavour
Texture
Over all acceptability

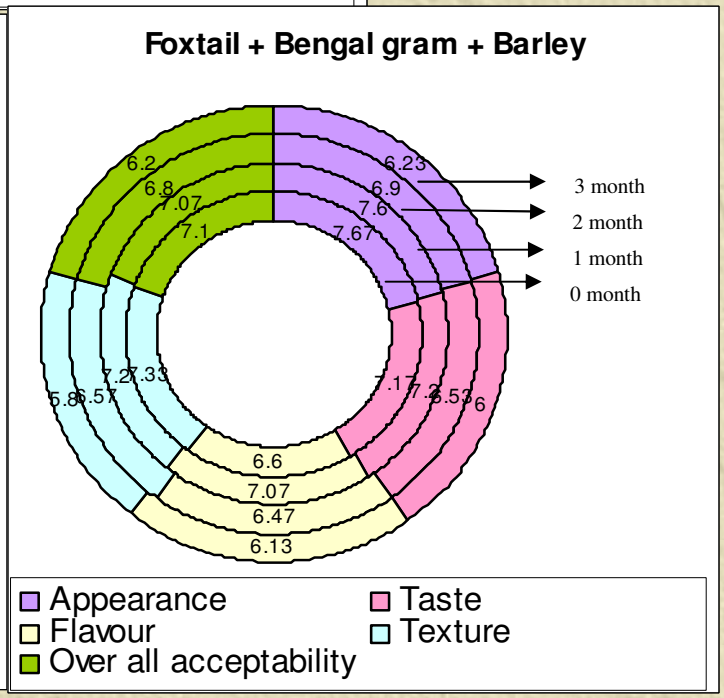

Maize
3 month
2 month
1 month
0 month
7.07
7.5
7.7
7.83
7.07
7.33
7.47
8.13
7.07
7.1
7.3
7.53
7.67
7.47
7.38
7.7
7.53
7.37
7.27
7.07
Appearance
Taste
Flavour
Texture
Over all acceptability


Maize + Bengal gram
3 month
2 month
1 month
0 month
7.03
7.17
7.13
7.53
6.93
6.97
6.93
7.87
7.17
7.07
6.9
7.33
7.57
6.98
6.97
6.47
7.1
6.87
7.07
7.13
Appearance
Taste
Flavour
Texture
Over all acceptability

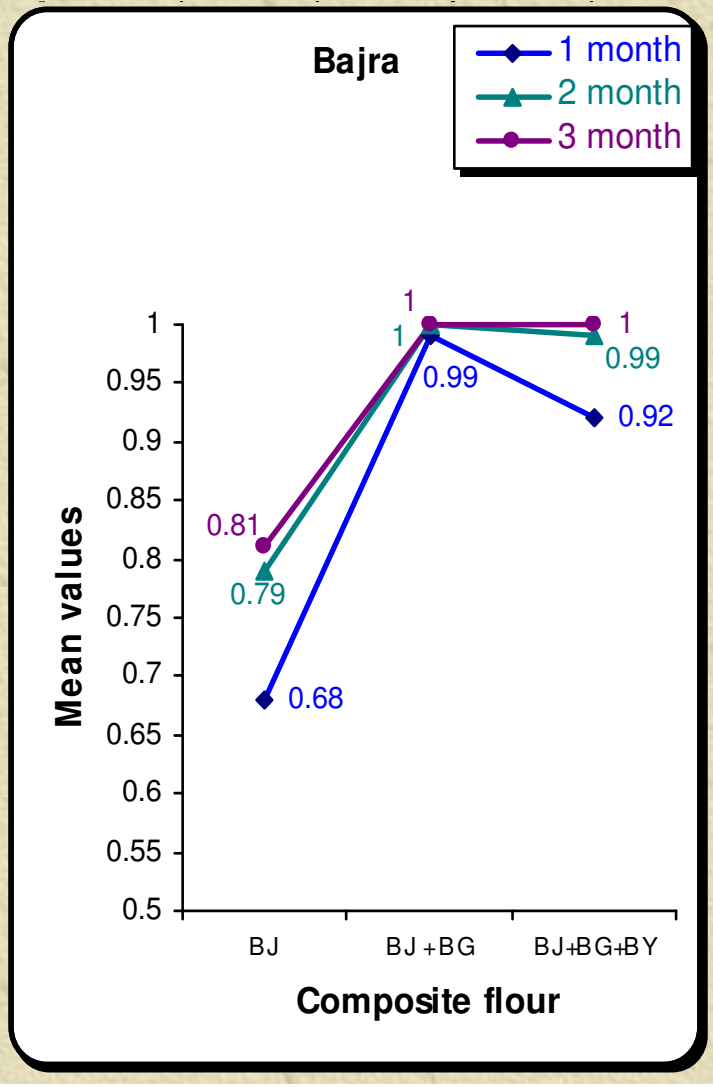

Maize + Bengal gram + Barley
3 month
2 month
1 month
0 month
6.57
7.2
7.3
7.5
7.03
7.17
7.37
8
7.1
7.07
7.1
7.3
7.37
7.2
7.27
6.97
Appearance
Taste
Flavour
Texture
Over all acceptability

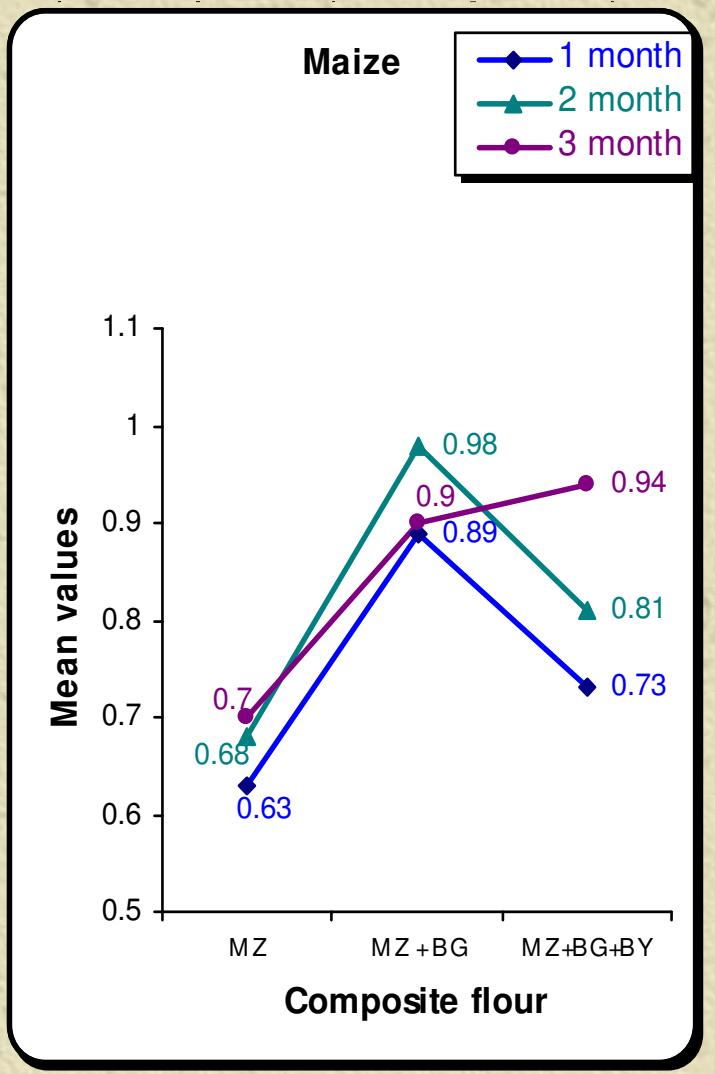

Foxtail
4.33
6.3
7.1
7.3
6
7.3
7.67
4.5
5.9
7.2
7.37
7.2
6.8
6.17
5
6.77
7.1
6.1
5.73
3 month
2 month
1 month
0 month
Appearance
Taste
Flavour
Texture
Over all acceptability

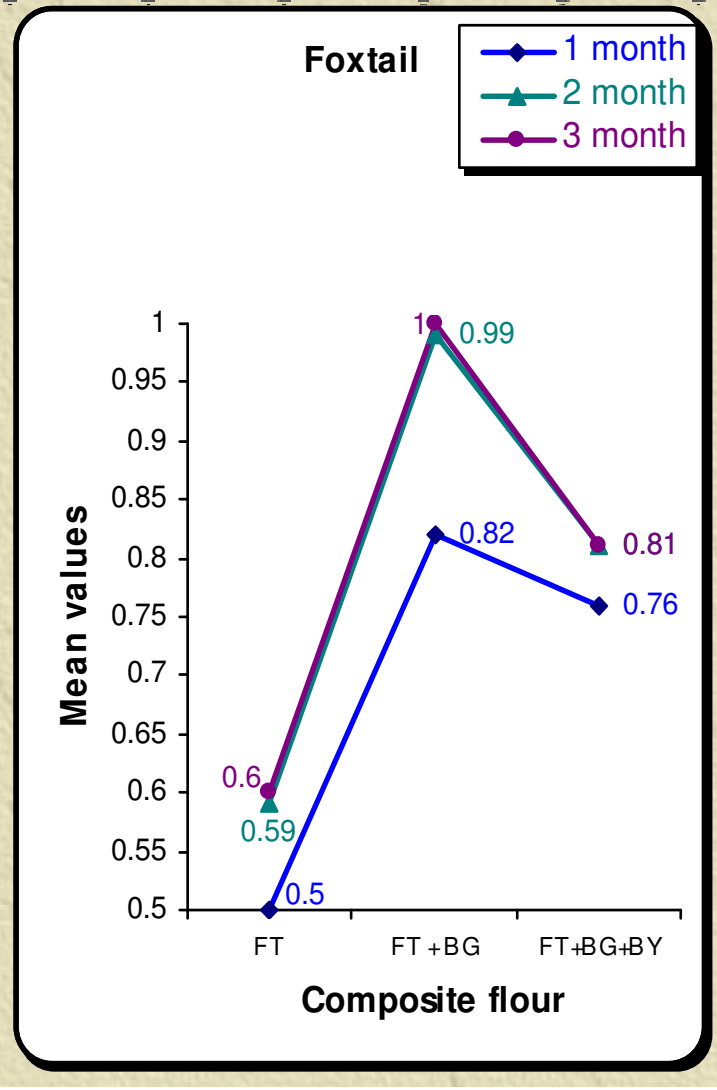

Foxtail + Bengal gram
6.03
6.73
6.9
7.27
6
6.53
7.27
7.5
6.37
7.1
7.27
7.2
6.9
7.53
5.9
6.77
6.9
6.33
5.93
3 month
2 month
1 month
0 month
Appearance
Taste
Flavour
Texture
Over all acceptability


Foxtail + Bengal gram + Barley
6.2
6.8
7.07
7.1
6.23
6.9
7.6
7.67
5.8
7.27
7.33
7.17
7.2
6.53
6
6.6
7.07
6.47
6.13
3 month
2 month
1 month
0 month
Appearance
Taste
Flavour
Texture
Over all acceptability

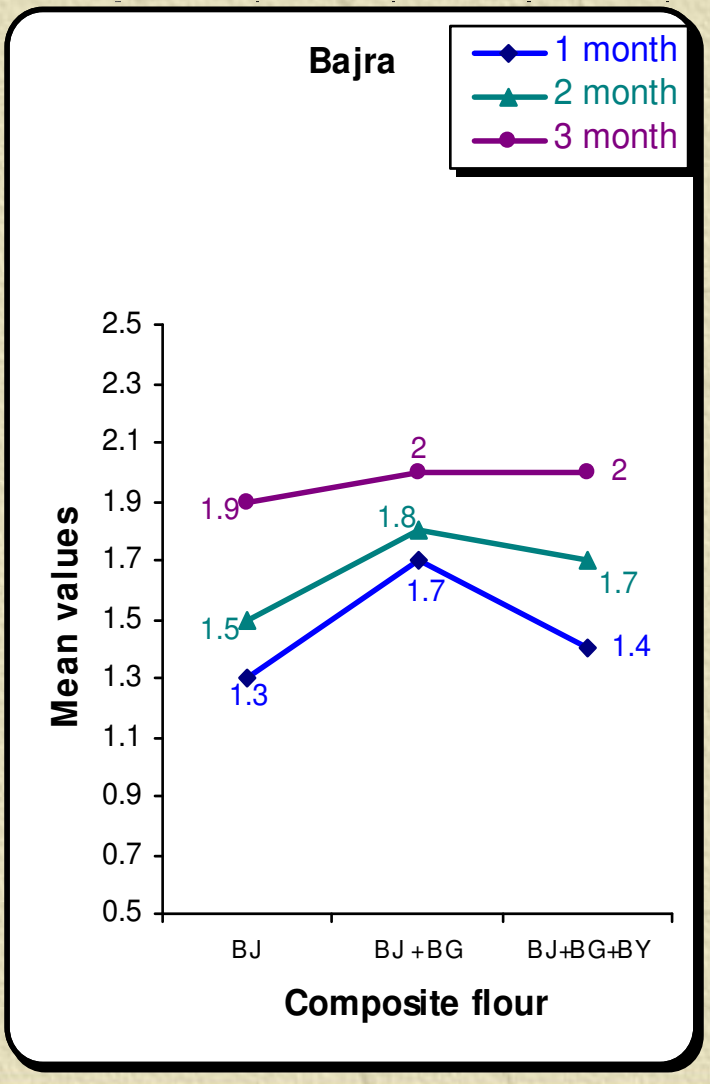
Acid Value of Composite Flour

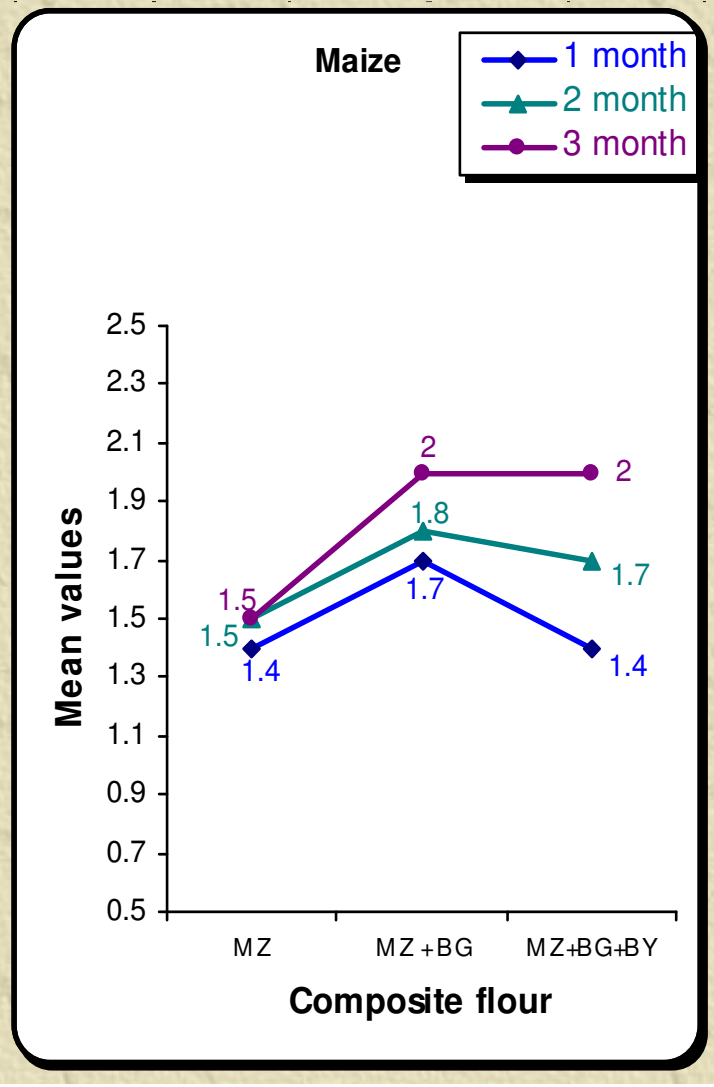


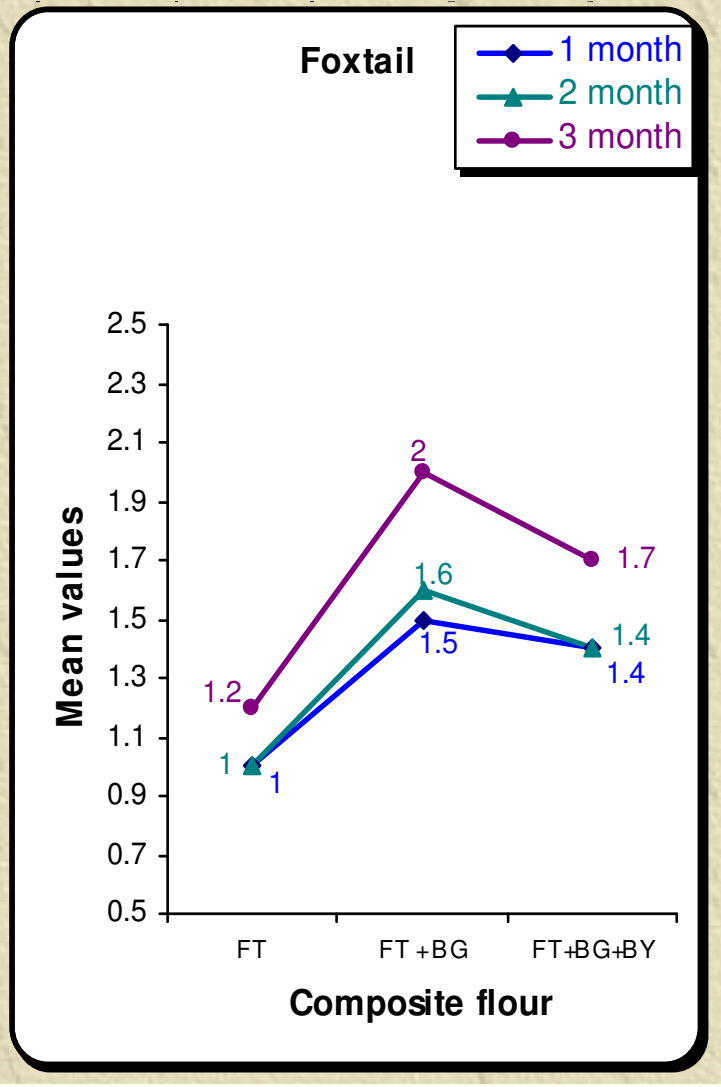

Maize
1 month
2 month
3 month
Mean values
1.1
1
0.9
0.8
0.7
0.6
0.5
0.98
0.9
0.89
0.94
0.81
0.73
0.7
0.68
0.63
MZ
MZ+BG
MZ+BG+BY
Composite flour


Foxtail
1 month
2 month
3 month
Mean values
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
0.6
0.55
0.5
1
0.99
0.82
0.81
0.76
0.6
0.59
0.5
FT
FT+BG
FT+BG+BY
Composite flour

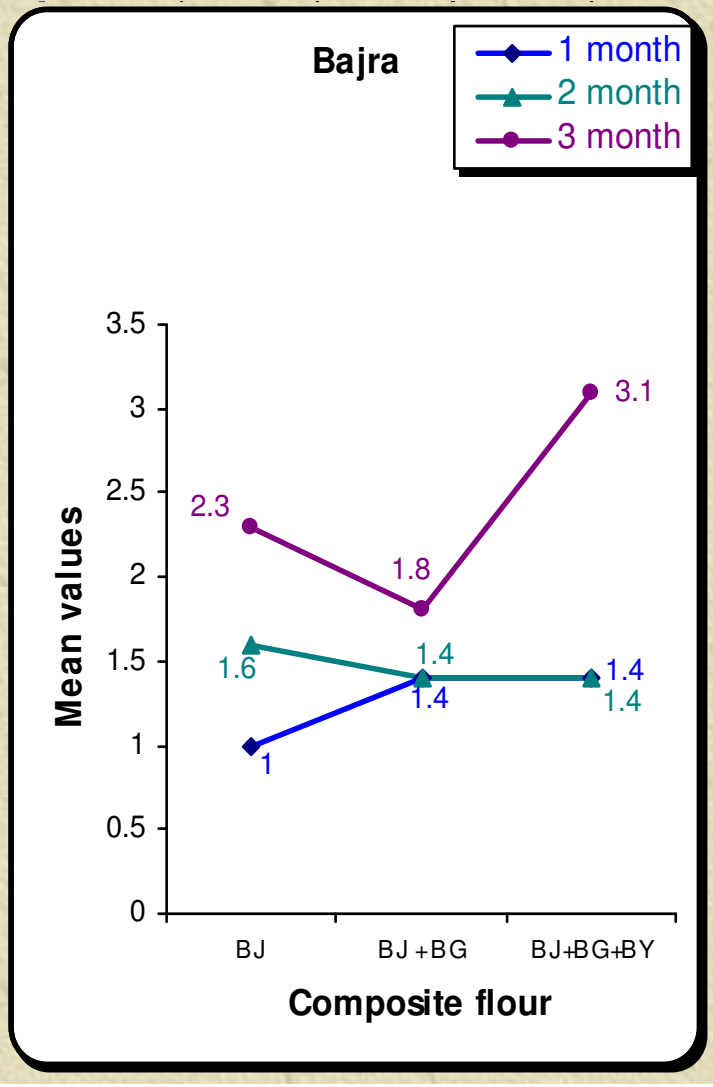
Alcoholic Acidity of Composite Flour

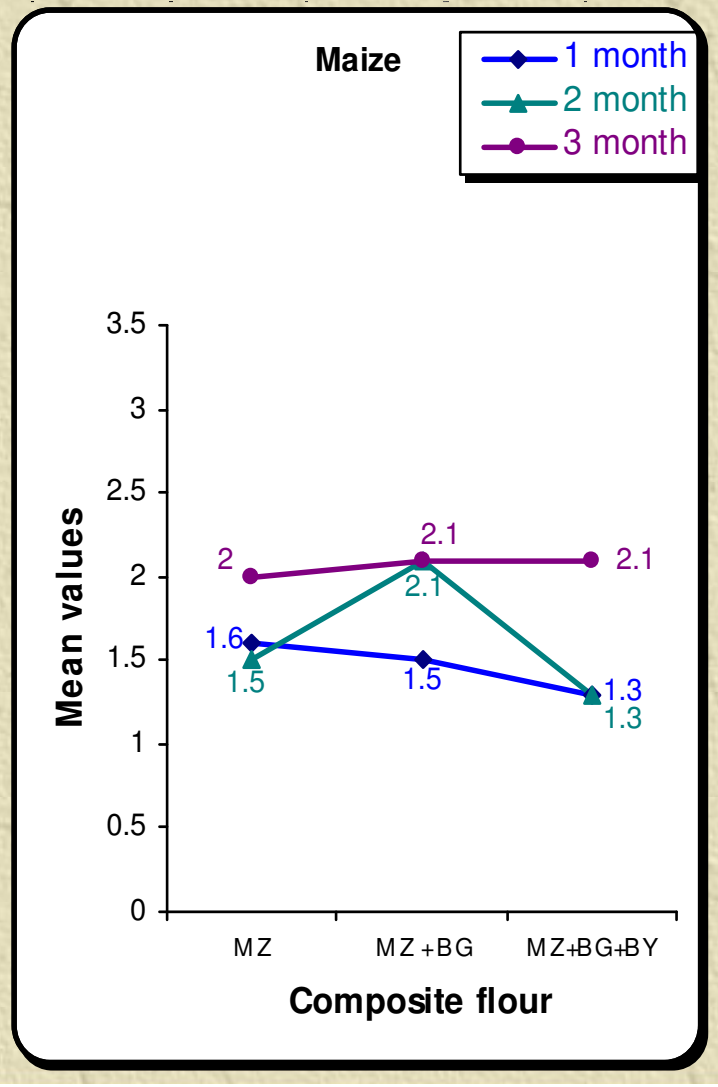


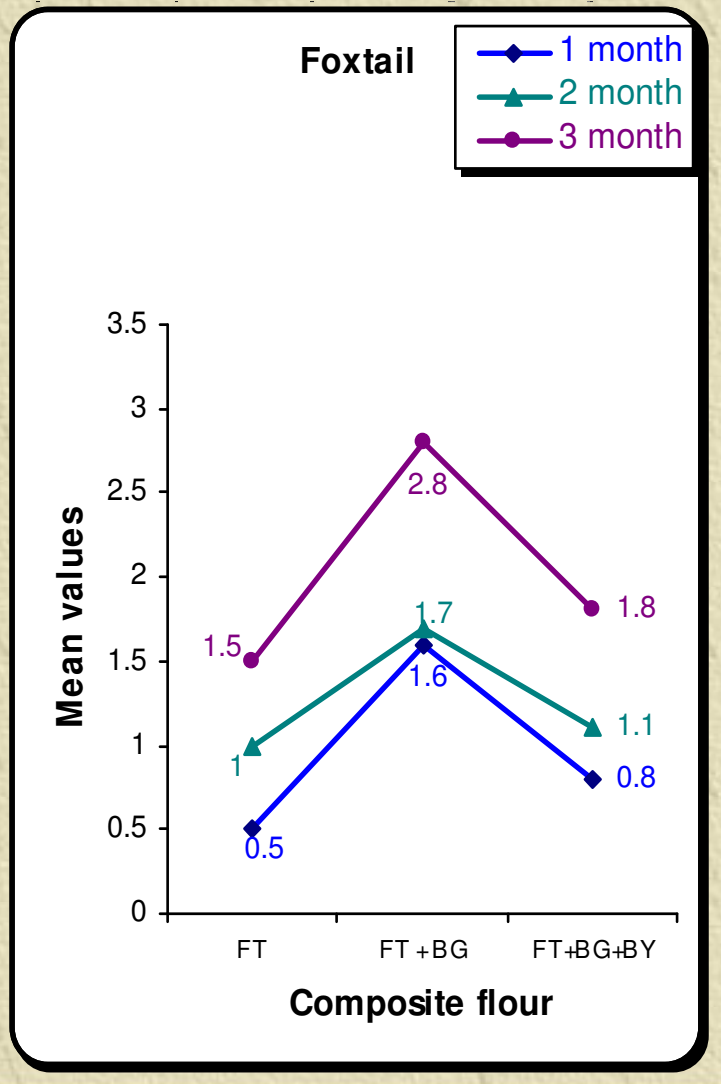

Maize
1 month
2 month
3 month
Mean values
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
0.7
0.5
2
2
1.8
1.7
1.5
1.5
1.7
1.4
1.4
MZ
MZ +BG
MZ+BG+BY
Composite flour


Foxtail
1 month
2 month
3 month
Mean values
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
0.7
0.5
2
1.7
1.6
1.4
1.5
1.4
1.2
1
1
FT
FT +BG
FT+BG+BY
Composite flour

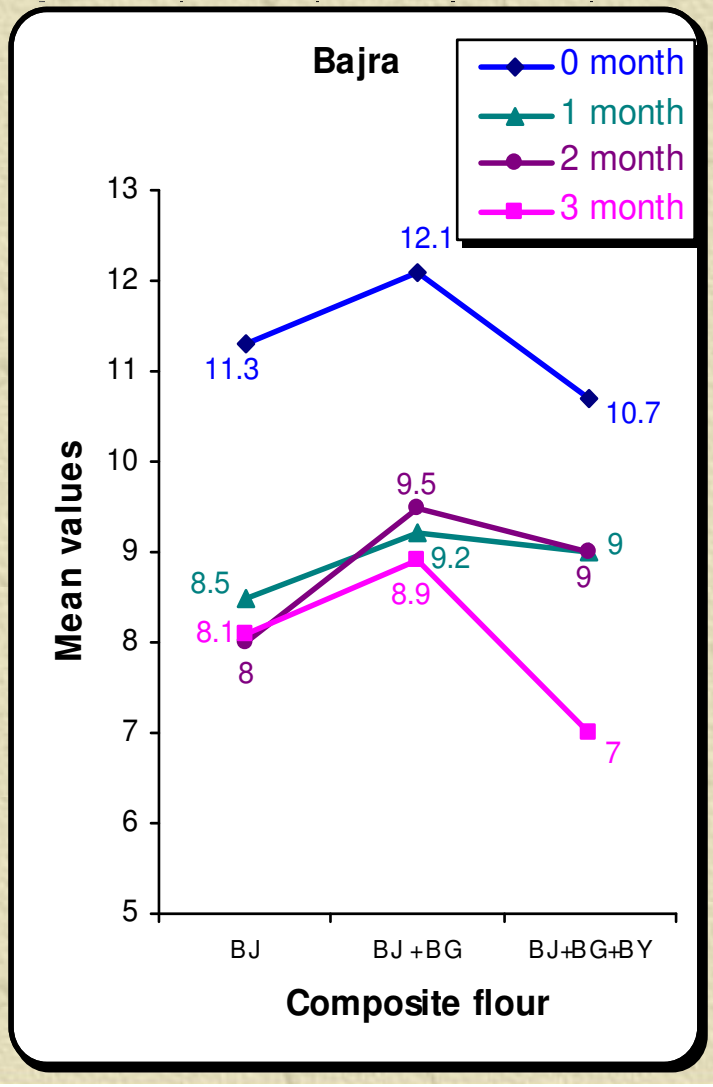
Peroxide Value of Composite Flour

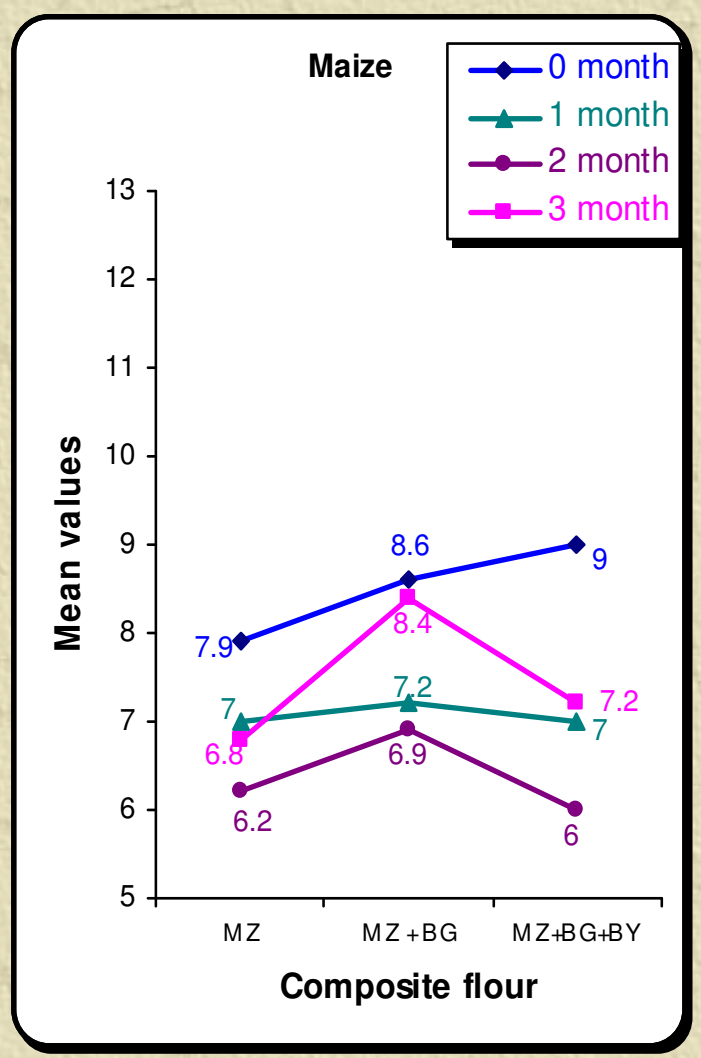


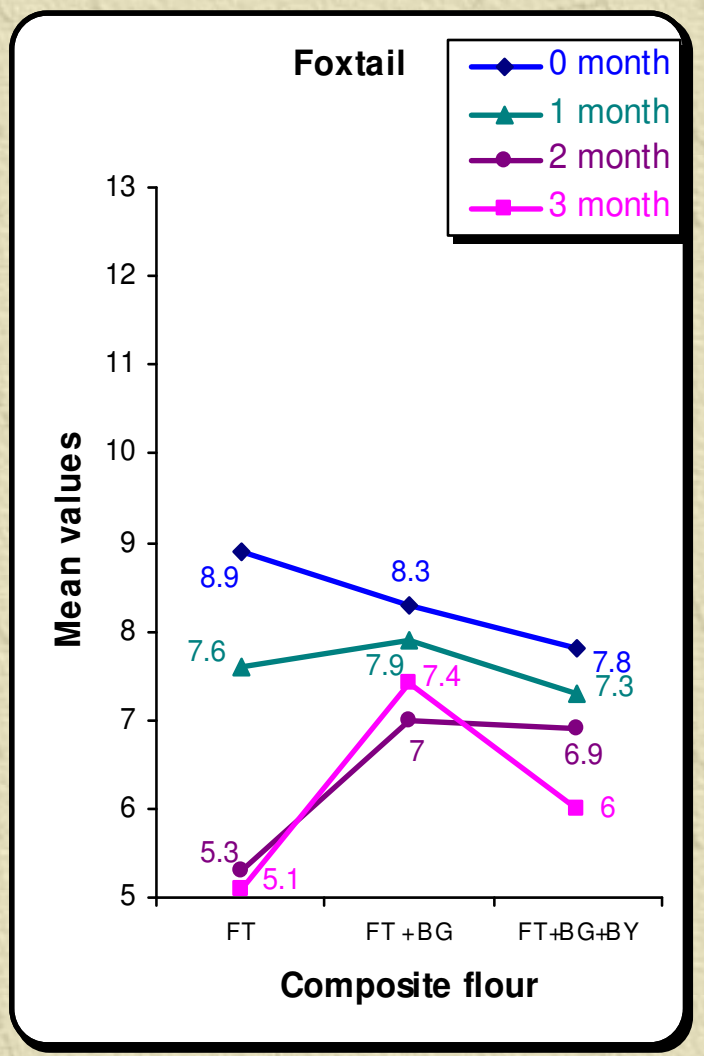

Maize
1 month
2 month
3 month
Mean values
3.5
3
2.5
2
1.5
1
0.5
0
2
2.1
2.1
1.6
2.1
1.5
1.5
1.3
1.3
MZ
MZ +BG
MZ+BG+BY
Composite flour


Foxtail
1 month
2 month
3 month
Mean values
3.5
3
2.5
2
1.5
1
0.5
0
2.8
1.8
1.5
1.7
1.6
1.1
1
0.8
0.5
FT
FT +BG
FT+BG+BY
Composite flour

Moisture content of composite flour




Maize
0 month
1 month
2 month
3 month
Mean values
13
12
11
10
9
8
7
6
5
8.6
9
7.9
8.4
7.2
7
7
7.2
6.8
6.9
6.2
6
MZ
MZ+BG
MZ+BG+BY
Composite flour


Foxtail
0 month
1 month
2 month
3 month
Mean values
13
12
11
10
9
8
7
6
5
8.9
8.3
7.8
7.6
7.9
7.4
7.3
7
6.9
6
5.3
5.1
FT
FT+BG
FT+BG+BY
Composite flour

Blood glucose response of composite flour

Table -8 : Prevalence of malnutrition

Body composition / indices	Type of malnutrition	Percentage		
		Diabetic . (n=5)	Non-diabetic (n=9)	Overall (N=14)
Weight percentage				
90 – 110	Normal	20	33.34	28.50
110 –120	Overweight	20	33.34	28.50
> 120	Obese	60	33.34	43
Height percentage				
90 – 105	Normal	100	100	100
Weight / Height				
90 – 110	Normal	40	56.0	50.0
110-120	Overweight	40	22.2	29.0
> 120	Obese	20	22.2	22.0
Body mass index				
20.0- 25.0	Normal	40	66.6	57.0
25.0- 30.0	Obese grade I	60	33.3	43.0
Waist hip ratio				
Male < 1.0	Below normal	60	44.5	50.0
Female >0.85	Abdominal obesity	40	55.5	50

Table -9 : Glycemic index of *missi roti*

Composite flour	Diabetic	Non-diabtic	Overall	'F' value
BJ	87±36.69	**68±17.09**	78±26.89	0.23
BJ + BG	57±8.85	50±11.20	54±10.03	0.25
BJ+BG+BY	85±33.57	63±35.32	74±34.44	0.001
MZ	89±35.28	58±9.02	74±22.15	0.69
MZ + BG	60±15.80	55±16.55	58±16.17	0.053
MZ+BG+BY	83±17.95	**34±3.46**	59±10.70	7.07*
FT	72±18.76	53±6.07	63±12.41	0.60
FT + BG	61±15.07	37±5.18	**49±10.12**	2.34
FT+BG+BY	74±23.78	37±11.94	56±17.86	1.93

*** Significant differnce**

CONCLUSION

- **Glycemic Index of *Missi Roti* was lower than the plain roti for all the millets.**
- **The lower Glycemic Index was observed in blends with bengalgram.**
- **The Glycemic Index of foxtail millet and its blend were lowest.**

THANK YOU