However, the moisture content for wheat flour, corn meal, and barley flour were nearly similar. The obtained values were 12.51%, 12.73%, and 13.10%, respectively.

These results were concord with those indicated by **Pechnik *et al.*, (1967)** as they found that moisture content of opaque-2-variety was 11.8%,. While, **Joen De Clerck (1957)** found that, moisture content of barley varied between 12-20%.

In this table, it is shown that, total lipids of wheat flour 72%, and barley flour were almost similar to each other. The values obtained were 1.21%, and 1.93%, respectively. On the other hand, corn meal had the highest ratio of total lipids of all raw materials as it was (4.13%). This result is concord with that obtained by **Mestress *et al.*, (1991)** who found that, lipids for yellow and white maize varieties from several African countries were 3.7-5.8%. Also, ash content (0.96-1.61%), this result agreed with data in Table (1).

Moreover, fiber content of wheat flour 72% was (0.63%) and this is in agreement with **Kentjones and Amos (1967)** who found that, fiber content of wheat flour ranged from 0.4% to 0.9% depending on the extraction rate.

Generally, the results, in Table (1) showed that, wheat flour 72% extraction was higher in protein, and total carbohydrates, whereas, corn meal was higher in total lipids, ash, and fiber, contents..

4.2 Chemical composition, physical, and sensory evaluation of produced cakes

4.2.1 Approximate chemical composition of produced cakes :

4.2.1.A Approximate chemical composition of butter cakes :

The obtained results of chemical composition for butter cakes are shown in Table (2).

Data indicated that, protein contents for all treatments shown in Table (2) are almost similar (8.80, 8.82, 8.81, 8.83%) for butter cake with and without pectin, lecithin and CMC, respectively.

Generally, the results mentioned in Table (2) showed that, protein digestability, lipids, ash, and total carbohydrates were almost similar.

These data were in agreement with those obtained by **Ranhotra *et al.*, (1993)** who found that moisture content of muffin was 15.6%, meanwhile, fat content was found to be 19.9-19.7% by **Ranhotra *et al.*, (1994)**.

4.2.2 Approximate chemical composition of sponge cakes :

The obtained results of chemical composition for sponge cakes with and without improvers (pectin, lecithin, and CMC 1%) are shown in Table (3). The data included protein, protein digestability, lipids, ash, and total carbohydrates.

Data shown in Table (3) of protein, ash, protein digestability, and total carbohydrates were almost similar among control either without improver or with improvers.

These data were in agreement with those obtained by **Camire and Flint (1991)** who found that, protein content of yellow corn meal was 9.2%. also, with **Ranhotra *et al.*, (1994)** who found the protein content of muffins was 6.4-6.7%.

4.2.3 Approximate chemical composition of butter cake with different ratios of different substitutions :

The obtained results of chemical composition of butter cake with different ratios of different substitutions are shown in Table (4).

Data in Table (4) represented control, 5, 10, 20% corn meal, and barley flour substitutions indicated that protein content for control was higher than all other treatments. Meanwhile, the lowest ratio of protein content was in the cake with 20% barley flour substitution being 8.30%.

These data agreed with what was given by **Ranhotra *et al.*, (1994)** who found that, protein content was 6.7-6.9% for types of muffins.

Meanwhile, substitution of barley flour had the higher ratio of total carbohydrates compared to corn meal substitutions, however, the highest value was observed with control sample 65.54%. These findings may be due to the increase in total carbohydrates of wheat flour, compared to corn meal and barley flour. These results are in agreement with those of **Ranhotra *et al.*, (1994)** as they found that, the carbohydrates content for air dried muffins was 63.1-62.40%.

Table (2) : Approximate chemical composition of butter cakes with/without improvers (on dry weight basis)

Butter cakes	Protein %	Protein digestability %		Lipids %	Ash %	Total carbohydrates %
		TD***	AD****			
Control* 100% wf**	8.80	76.99	64.28	25.03	0.63	65.54
Control + Pectin 1%	8.82	76.90	64.14	25.05	0.64	65.49
Control + Lecithin 1%	8.81	75.80	63.10	26.06	0.68	64.45
Control + CMC 1%	8.83	75.30	62.62	25.04	0.69	65.44

Control* : 100% wheat flour 72% extraction
wf** : Wheat flour 72% extraction
CMC = Carboxy methyl cellulose

T.D*** : True protein digestability
A.D**** : Appearant protein digestability

Table (3) : Approximate chemical composition of sponge cakes with/without improvers (%on dry weight basis)

Sponge cakes	Protein %	Protein digestability %		Lipids %	Ash %	Total carbohydrates %
		TD***	AD****			
Control* 100% wf**	9.03	78.66	65.79	3.30	0.62	87.05
Control + Pectin 1%	9.04	78.56	65.70	3.31	0.62	87.03
Control + Lecithin 1%	9.03	78.50	65.64	4.32	0.61	86.27
Control + CMC 1%	9.04	78.42	65.56	3.32	0.61	87.03

Control* : 100% wheat flour 72% extraction
wf** : Wheat flour 72% extraction
CMC = Carboxy methyl cellulose

T.D*** : True protein digestability
A.D**** : Appearant protein digestability

Table (4) : Approximate chemical composition of butter cake with substitutions (on dry weight basis)

Composition	Control	Corn meal			Barley flour		
		5%	10%	20%	5%	10%	20%
Protein %	8.80	8.52	8.44	8.32	8.49	8.38	8.30
Protein digestability							
TD	76.99	75.99	74.80	73.43	75.99	74.96	74.00
AD	64.21	64.20	62.15	60.86	63.27	62.30	61.40
Lipids %	25.03	25.26	25.48	25.67	25.13	25.19	25.22
Ash %	0.63	1.07	1.13	1.17	1.07	1.11	1.15
Total carbohydrates %	65.54	65.15	64.95	64.84	65.31	65.32	65.33

Concerning ash content the control sample had the lowest value being 0.63%, on the other hand, lipids contents were almost similar for all treatments.

Concerning the protein digestability, samples containing barley flour had higher value compared to that contained corn meal.

4.2.4 Approximate chemical composition of sponge cake with different ratios of different substitutions :

The obtained results of the chemical composition of sponge cakes produced from mixed wheat flour 72% extraction with corn meal, and barley flour as 5%, 10%, and 20% ratios, frequently, are shown in Table (5).

Data presented in Table (5) indicated that, barley substitutions were different in the total carbohydrates of 5%, 10%, and 20% corn meal or barley flour, relative to control.

These results agreed with those given by **Bhattacharya and Hanna (1987)** as they found that, the chemical composition of total carbohydrates of ground corn and whole waxy corn were 86.45 and 89.20%, respectively.

Concerning the lipids content, data showed increasing in lipids content parallel with increasing corn meal percentage. The highest value 3.85% was observed with 20% corn meal. This may be due to the high lipids content of corn meal, compared to wheat flour 72% extraction. These data are in agreement with those obtained by **Mestress *et al.*, (1991)** who reported that, yellow and white maize varieties from several African countries

Table (5) : Approximate chemical composition of sponge cake with substitutions (on dry weight basis)

composition	Control	Corn meal			Barley flour		
		5%	10%	20%	5%	10%	20%
Protein %	9.03	8.70	8.39	8.20	8.68	8.54	8.37
Protein digestability TD	78.66	77.29	76.63	75.06	77.59	76.79	75.76
AD	69.16	65.14	65.17	65.15	65.16	65.17	65.18
Lipids %	3.30	3.50	3.70	3.85	3.40	3.53	3.67
Ash %	0.62	1.08	1.13	1.22	1.07	1.11	1.22
Total carbohydrates %	87.05	86.81	86.78	86.73	86.85	86.82	86.74

contained about 3.7-5.8% lipids. Also, agree with **David (1974)** who found that, barley flour contains 2.2% lipids.

On the other hand, concerning protein content, decreased with increasing corn meal or barley flour portions. These data agree with **Charles *et al.*, (1985)** who found that protein content of flour used for angel cakes ranged from 7.1% to 11.5% Also, these data concord with protein content of raw materials 11.42 wheat flour, 9.11% corn meal and 8.99% wheat flour.

Meanwhile, protein digestability shown in Table (5), indicated that, control treatment had the highest value of protein digestability, as it was 78.66%, on the other hand, for the treatments 5, 10, 20% substitutions of corn meal, or barley flour, it had a gradual slight reduction from the control treatment.

Ash content, control treatment had the lowest ratio, as it was 0.62% relative to the other treatments. On the other hand, barley flour 20% had the highest ratio of ash content., 1.22%. These findings agreed with **David (1974)** who noticed that, barley flour contains 2.1% ash and **Abd El-Magied *et al.*, (1991)** who found that, wheat flour 72% extraction had 0.60% ash content.

4.2.5 Approximate chemical composition of cracker product with corn meal substitution :

Data presented in Table (6) show the chemical composition for cracker products (Bretzil) made from mixed 20% corn meal with 80% wheat flour 72% extraction.

Table (6) : Approximate chemical composition of cracker products (on dry weight basis)

Cracker products	Protein %	Protein digestability %		Lipids %	Ash %	Total carbohydrates %
		TD	AD			
Control	9.98	76.48	63.73	9.86	0.66	79.50
(1)	9.86	74.67	62.03	10.16	0.70	79.28
(2)	9.89	75.72	63.02	10.18	0.71	79.22
(3)	9.85	75.60	62.21	10.19	0.72	79.24
(4)	9.87	75.45	62.77	10.17	0.74	79.22
(5)	9.86	74.89	62.24	10.19	0.75	79.20
(6)	9.85	74.67	62.03	10.21	0.76	79.18

(1) Mahlab 1% + yeast 1%
(2) Mahlab 1% + lecithin 1% + malt barley 1.5%
(3)Mahlab 1% + lecithin 1% + malt barley 1.5% + yeast 1%
(4)Malt 1.5% + yeast 1%
(5)Lecithin 1%
(6)Lecithin 1% + yeast 1%

Table (7) : Minerals content mg/100g of raw materials used

Raw materials	Mg	Na	Zn	Mn	Fe	Ca	K
Wheat flour 72% extraction	17.57	18.59	0.69	1.51	1.32	18.83	93.00
Corn meal	34.59	85.75	1.94	2.77	7.91	19.02	67.58
Barley flour	31.20	105.02	1.64	2.95	9.76	102.77	215.82
Mahlab	40.54	74.44	1.51	1.88	7.62	163.70	241.22

Concerning the protein digestability of treatments with malt had slight high ratios of protein digestability such as treatment no. 2, 3, 4 more than the rest of the treatments.

On the other hand, control without any addition had the highest value of protein digestability, as it was 76.48%.

Dealing with lipids content, all treatments were almost similar results; whereas, control (cracker produced) was the lowest value of lipid.

Generally, the cracker products were almost similar for protein, ash, and total carbohydrates.

4.3 Minerals content mg/100g of raw materials, butter cakes, sponge cake and cracker products :

This determination made by using atomic absorption spectrophotometer. These results indicated some differences of Mg, Na, Zn, Mn, Fe, Ca, K for the raw materials.

Concerning wheat flour contents of Mg, Na, Zn, Mn, Fe, Ca, and K were lower ratios than corn meal or barley flour. These results agreed with **Anonymous (1977)** who reported that, dietary fiber might support certain minerals such as Ca, Zn, Fe, Cu, and Mg. All these results are shown in Table (7).

Meanwhile corn meal had higher ratios of Mg, Zn and Mn compared to the others.

Data in Table (8) for control and butter cake with improvers (pectin, lecithin, and CMC) indicated that, all ratios of Mg, Na, Zn, Mn, Fe, Ca, and K were almost similar except for

Table (8) : Minerals content mg/100g of butter cakes with/without improvers

Raw materials	Mg	Na	Zn	Mn	Fe	Ca	K
Control 100% W.f.	17.55	18.60	0.67	1.51	1.32	18.83	92.99
Butter cake + pectin	17.60	18.66	0.70	1.55	1.33	25.13	102.30
Butter cake + lecithin	17.62	18.63	0.69	1.54	1.34	18.93	93.21
Butter cake + CMC	17.56	18.60	0.69	1.51	1.32	18.82	92.99

Table (9) : Minerals content mg/100g of sponge cakes with/without improvers

Raw materials	Mg	Na	Zn	Mn	Fe	Ca	K
Control 100% (72% wheat flour)	17.58	18.61	0.69	1.51	1.32	18.84	93.03
Sponge cake + pectin	17.57	18.63	0.70	1.51	1.44	28.92	105.22
Sponge cake + lecithin	17.57	18.62	0.69	1.51	1.32	18.84	93.00
Sponge cake + CMC	17.57	18.62	0.69	1.51	1.32	18.84	93.02

butter cake with pectin which revealed that it was the highest ratio of Ca and K (25.13 and 102.30 mg/100g), respectively.

Regarding the data in Table (9) for sponge cake, as control, sponge cake plus pectin, sponge cake plus lecithin, and sponge cake plus CMC 1%, respectively.

Data indicated that, sponge cake with pectin was the highest ratios of Ca and .K.

Dealing with mineral contents with substitution of butter cake, data presented in Table (10) showed that, butter cake with 20% substitution corn meal had the highest ratio of magnesium. Meanwhile, the lowest ratio of magnesium was found in the control. On the other hand, 20% barley flour substitutions had the highest ratio of sodium; meanwhile, the control was the lowest ratio, concerning zinc, was slightly increased in 20% substitution of corn meal and barley flour. Dealing with Mn (manganese element), the highest ratio was with 20% corn meal substitution. Calcium was the highest ratio in 20% barley flour substitution; meanwhile, the lowest ratio was in control.

Meanwhile, 10% corn meal slightly increased ratio of magnesium and manganese compared to 10% barley flour.

On the other hand, 20% substitution of corn meal was higher ratio of (Mg, Na, Zn) than 20% barley flour substitution. Regarding other treatments 5, 10% barley flour, corn meal substitution. Data indicated that 5, 10% corn meal were the higher ratio than 5, 10% barley flour of (Mg, Na, and Zn). Generally, 20% barley flour had the highest ratio of potassium.

Data in Table (11) revealed that, in sponge cake (control) had the lowest ratios of magnesium, sodium, zinc, manganese,

Table (10) : Minerals content of butter cake with substitutions (mg/100g)

Treatments	Control	Corn meal			Barley flour		
		5%	10%	20%	5%	10%	20%
Mg	17.55	19.64	21.51	23.01	18.47	19.61	20.83
Na	18.60	20.61	22.64	26.70	20.70	23.70	29.01
Zn	0.67	0.73	0.78	0.82	0.74	0.77	0.81
Mn	1.51	1.71	1.90	2.13	1.63	1.70	1.80
Fe	1.32	1.63	1.92	2.11	1.72	2.10	2.52
Ca	18.83	18.91	18.97	19.03	23.83	28.92	34.12
K	92.99	90.58	89.00	87.98	104.28	115.22	126.02

Table (11) : Minerals content of sponge cake with substitutions (mg/100g)

Treatments	Control	Corn meal			Barley flour		
		5%	10%	20%	5%	10%	20%
Mg	17.58	19.33	21.60	23.49	18.44	19.46	20.12
Na	18.61	20.70	22.81	26.60	20.60	23.61	29.02
Zn	0.69	0.75	0.83	0.96	0.73	0.81	0.92
Mn	1.51	1.63	1.76	1.88	1.62	1.70	1.82
Fe	1.32	1.67	1.97	2.12	1.72	2.12	2.52
Ca	18.84	19.03	19.93	21.12	23.20	28.62	33.60
K	93.03	90.69	88.69	86.98	104.69	114.39	127.01

iron, and calcium. On the other hand, substitution of 20% corn meal had the highest ratios of magnesium. Meanwhile, 20% substitution of barley flour had the highest ratios of zinc, manganese, iron, calcium, and potassium.

Whereas, 5% substitution of corn meal had slight increasing of magnesium than 5% substitution of barley flour. Also, of sodium, meanwhile, 5% substitution of barley flour had slightly increased of iron, calcium, and potassium.

In the same table, data indicated that, 10% substitution of corn meal had decreased ratio of sodium, iron, calcium, and potassium compared to 10% barley flour substitution.

Data presented in Table (12) showed that, the results of minerals content for cracker products made from mixed corn meal 10% with wheat flour 72% extraction 90%. The results indicated that control treatment had the lowest ratios of Mg and Na. Meanwhile, it had similar ratio of zinc with treatment No (1), Mn with treatments No (5), also, similar of iron with treatment No (5), and, similar with treatment No (5) of K.

Dealing with the other treatments, data showed that, treatment No (1) had the highest ratios of magnesium. Meanwhile, treatment No (2) had the lowest ratios of it.

On the other hand, all treatments were rich in sodium. Also, treatments No (2, 3 and 4) had the highest ratios of calcium and potassium.

Table (12) : Minerals content of cracker products (mg/100g)

Minerals	Control	No. of treatments					
		1	2	3	4	5	6
Mg	17.58	19.29	18.11	18.13	18.40	19.66	19.21
Na	18.61	22.42	23.90	23.96	24.10	23.69	23.72
Zn	0.70	0.71	0.64	0.64	0.60	0.59	0.73
Mn	1.51	1.67	1.83	1.83	1.83	1.50	1.57
Fe	1.32	1.74	1.75	1.76	1.76	1.31	1.63
Ca	18.85	19.56	23.88	23.90	23.90	18.82	18.91
K	93.00	90.30	100.42	100.45	100.43	92.89	92.88

(1) Mahlab 1% + yeast 1%
(2) Mahlab 1% + lecithin 1% + malt barley 1.5%
(3)Mahlab 1% + lecithin 1% + malt barley 1.5% + yeast 1%
(4)Malt 1.5% + yeast 1%
(5)Lecithin 1%
(6)Lecithin 1% + yeast 1%

4.4 Physical properties of cake products :

4.4.1 Rheological properties of farinograph and extensograph :

Hoseney (1986) stated that, many factors had effect on rheological properties : (1) gluten of protein, (2) water and water-soluble fraction of flour.

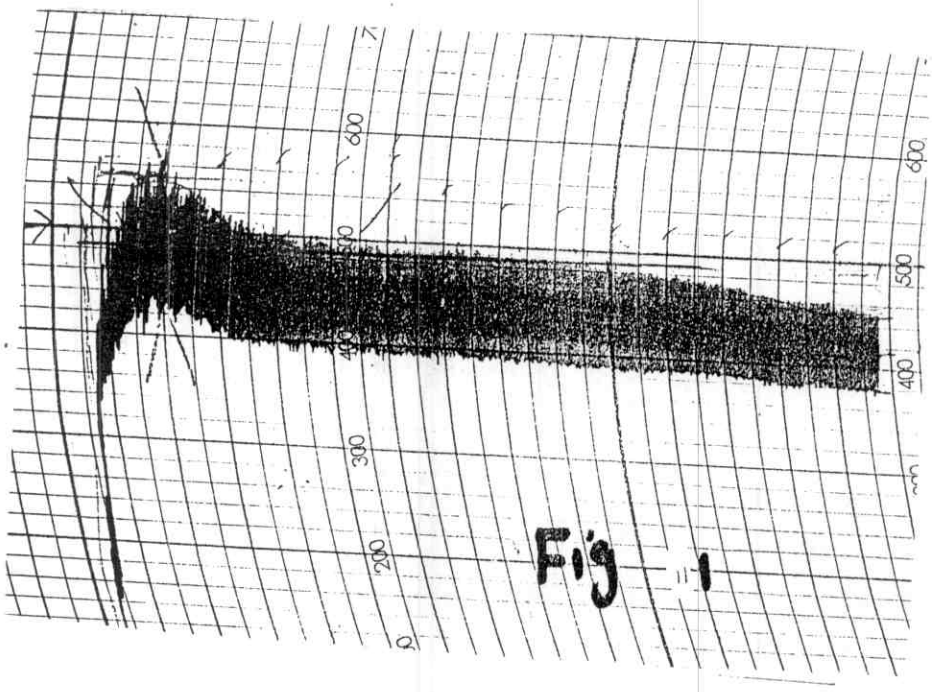
Data in Table (13) and Figs (1-10) (farinograms) of raw materials used to produce cake, included absorption of water (ml), arrival time (min), stability time (min), developing time (min), weakening (B.U.) after 12 min.. Concerning water absorption in the same table, it was shown that, control sample 100% wheat flour 72% extraction recorded 55.8ml, meanwhile, adding 5%, 10%, and 20% corn meal increased slightly the water absorption, being 55.9, 56.00, and 56.4ml, respectively.

Also, adding 5, 10 and 20% barley flour increased the water absorption, being 56.0, 56.2, and 57.4ml, respectively. Concerning the improvers which added to produce the cake and improve the shelf life or reduce the staling rate, data indicated that, adding pectin 1% to 5% corn meal, it was 56.7ml as water absorption, meanwhile, 5% barley flour plus pectin, it was 57.8ml as water absorption.

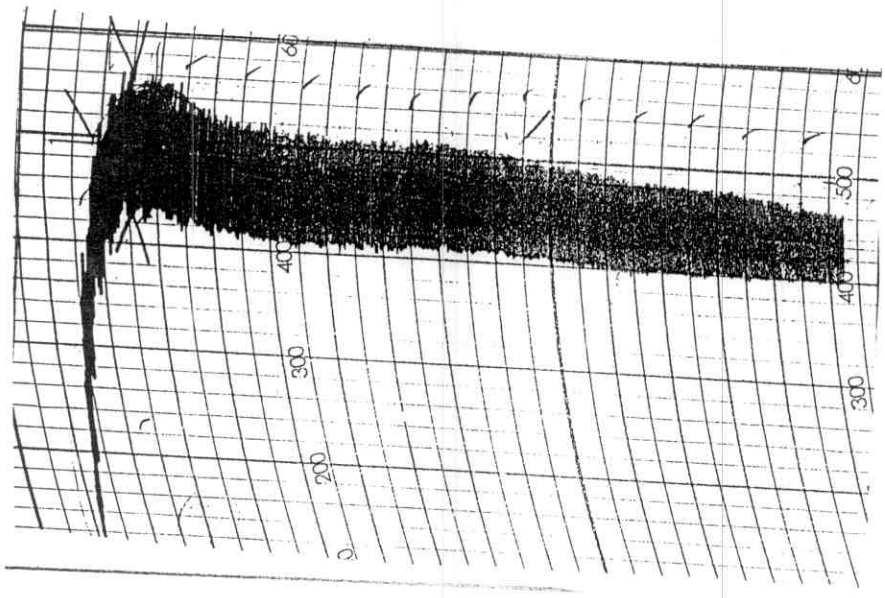
Also, adding CMC to raw materials by 5% substitutions corn meal, and barley flour, it was 56.5, and 57.6ml as water absorption, respectively.

Table (13) : Effect of substitution of wheat flour with some cereal flours and improvers on the farinogram parameter

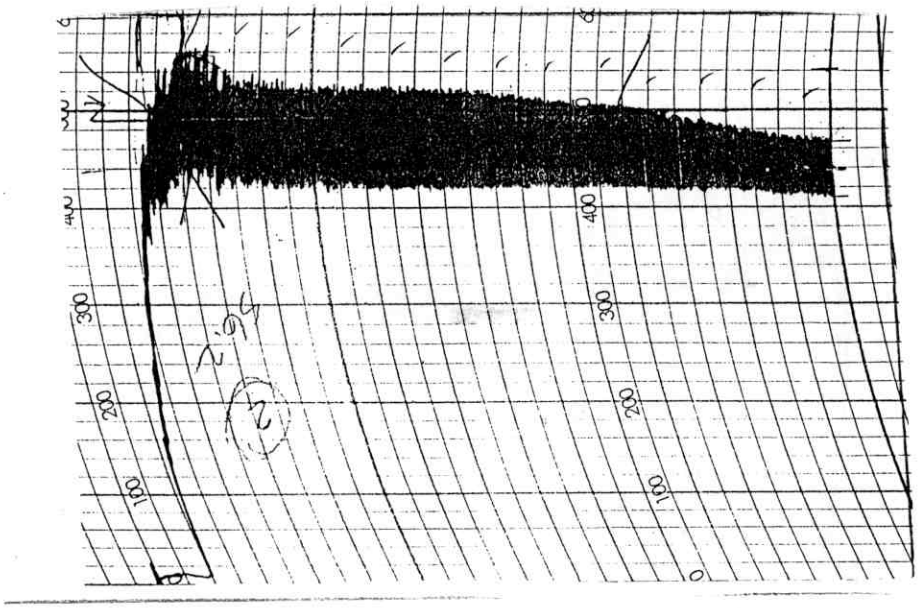
Raw materials	Water Absorption (ml)	Arrival time (min)	Stability time (min)	Developing time (min)	Weakening after 12 min (B.u)
Control (100% w.f 72%)	55.8	1.0	8.0	2.0	80
5% barley flour + 95% w.f 72%	56.0	1.0	9.0	2.0	70
10% barley flour + 90% w.f	56.2	1.0	9.5	1.5	60
20% barley flour + 80% w.f	57.4	¾	8 ¼	1 ½	80
5% barley flour + 1% CMC +95% w.f	57.6	1.0	6.0	1 ½	85
5% barley flour + 1% pectin +95% w.f	57.8	¾	6 ¾	1 ½	90
5% corn meal + 95% w.f 72%	55.9	¾	5.0	1 ½	100
10% corn meal + 90% w.f 72%	56.0	¾	3.0	1 ½	110
20% corn meal + 80% w.f 72%	56.4	¾	4.0	1 ¼	110
5% corn meal + 1% pectin +95% w.f	56.7	¾	4.5	1 ¼	110
5% corn meal + 1% CMC +95% w.f	56.5	¾	3.5	1 ¼	120



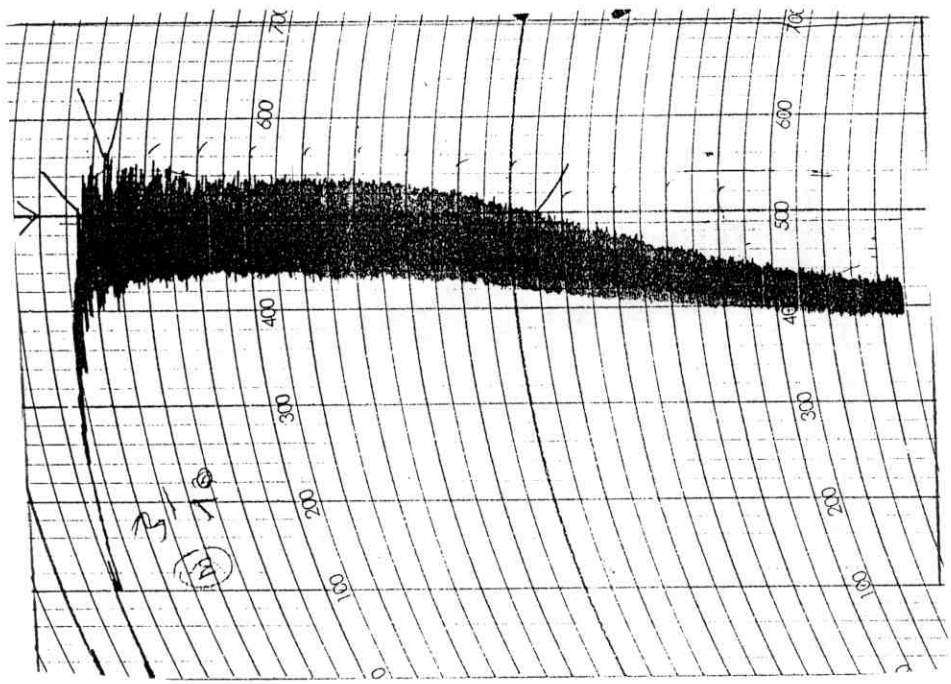
Control 100%W.F 72% extraction



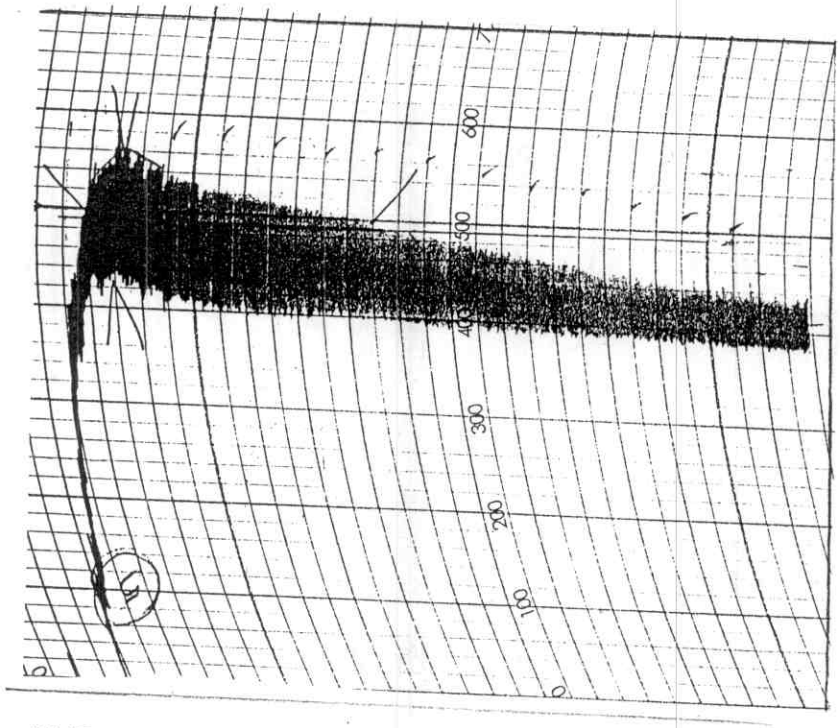
5% Barley flour + 95% W.F 72% extraction



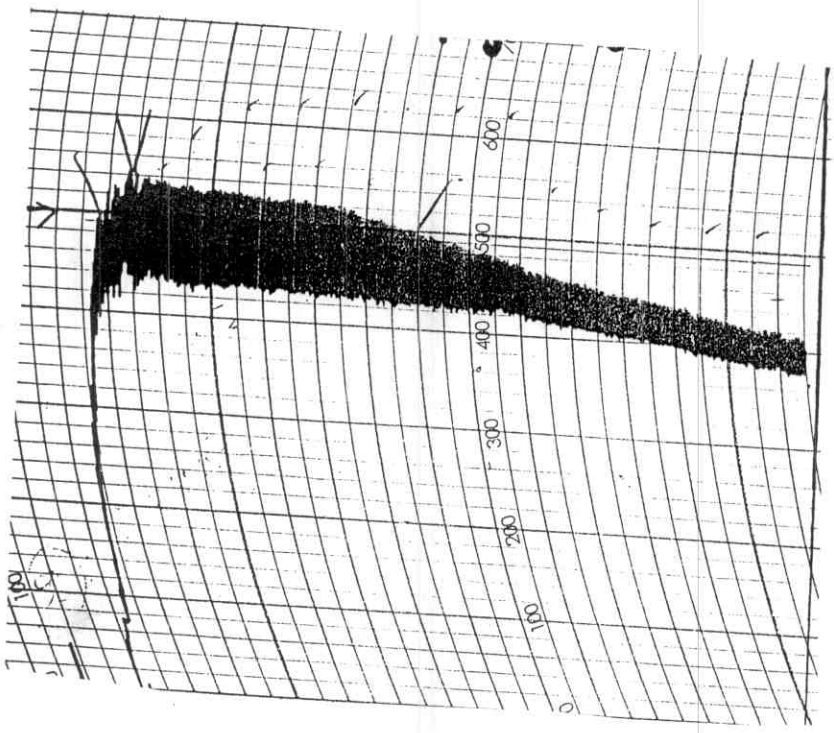
10% Barley flour + 90% W.F 72% extraction



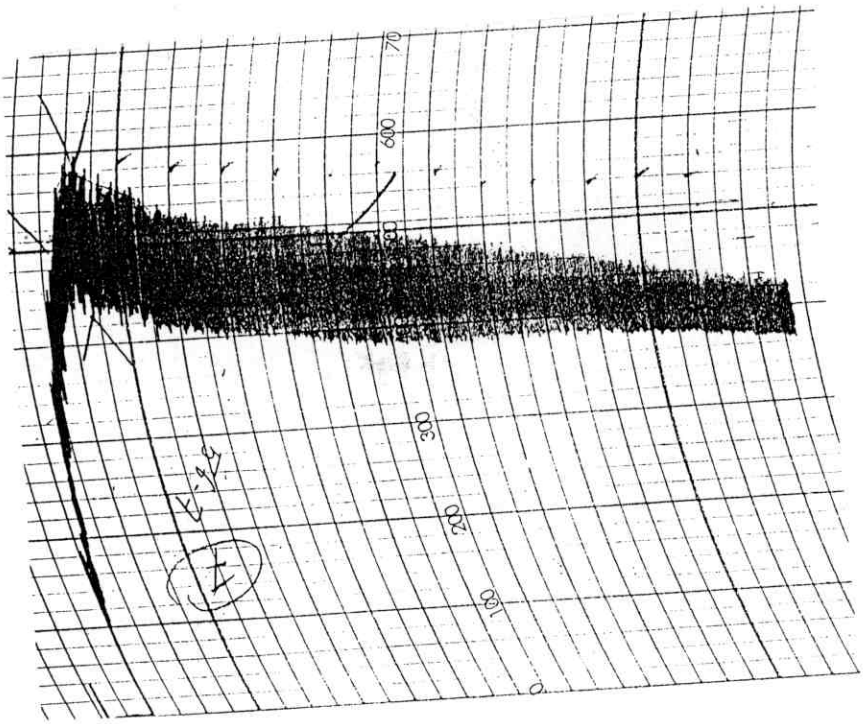
20%Barley flour + 80% W.F 72% extraction



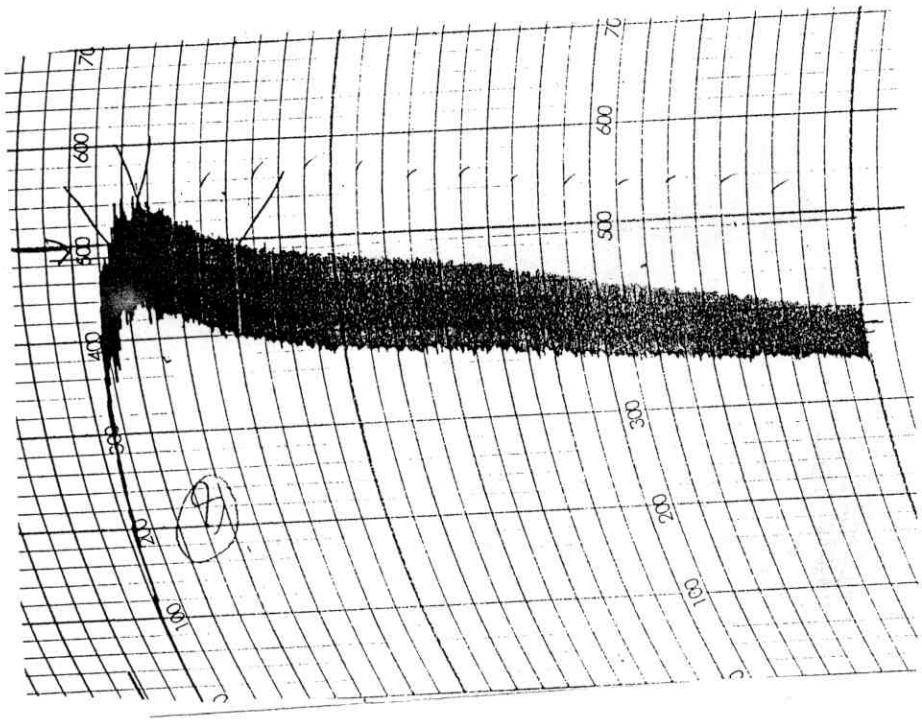
5%Barley flour + 1% CMC + 95% W.F 72% extraction



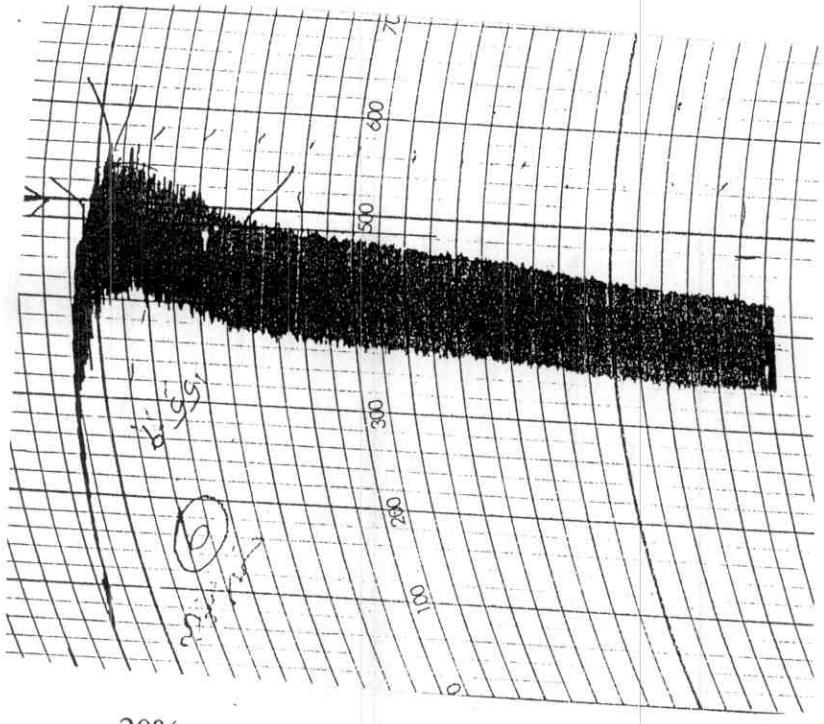
5%Barley flour + 1% pectin + 95% W.F 72% extraction



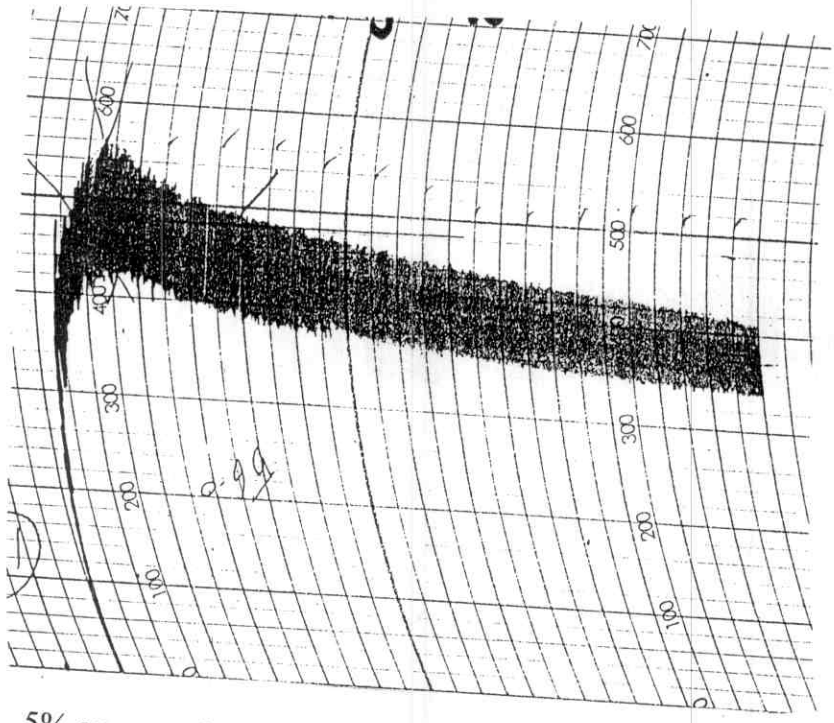
5% corn meal + 95 W.F 72% extraction



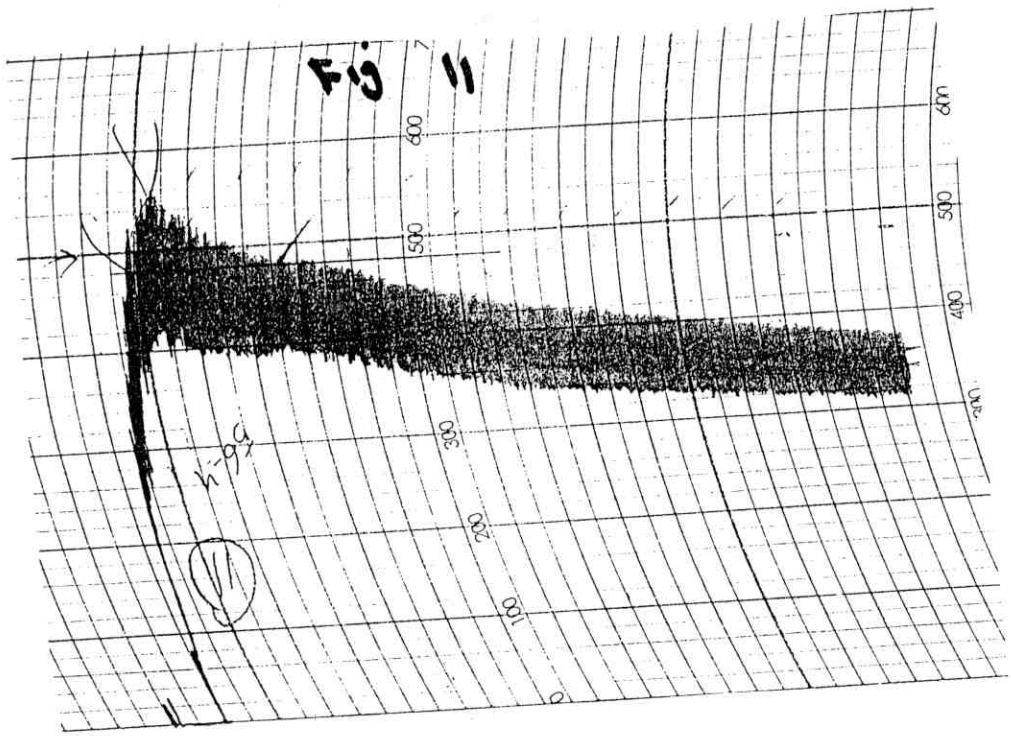
10% corn meal + 90% W.F. extraction



20% corn meal + 80% W.F. 72% extraction



5% corn meal + 1% pectin + 95% W.F 72% extraction



5% corn meal + 1% CMC + 95% W.F. 72% extraction

These results agree with **Chen *et al.*, (1988)** who found that fiber increased the water absorption of wheat flour and this may be due to the water bending ability of fiber.

Dealing with arrival time (min), data revealed that, control 100% wheat flour 72% had the same arrival time with 5%, 10% barley flour, and 5% barley flour plus CMC 1%.

Also, in the same table, data for developing time were the highest time for control 100% wheat flour, and 5% barley flour substitution.

Meanwhile, 10%, 20% barley flour, and 5%, 10%, 20% corn meal reduced developing time compared to control and 5% barley flour substitution

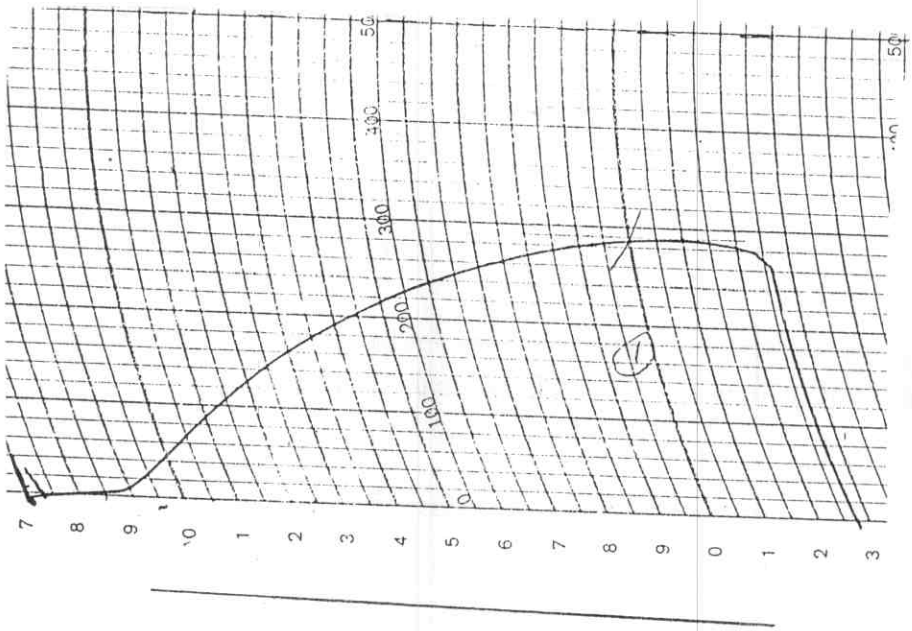
These data are in agreement with those obtained by **Irvlne *et al.*, (1960)** who reported that, variation of protein content, temperature, absorption or particle size produces a distinct change in Farinogram characteristics. Also, reported that, as absorption of water increases, dough development time decreases. Data in the same table, showed that, weakening (B.U.) after 12 min for 10% barley flour substitution was the lowest value. Meanwhile, gradually increased the weakening (B.U.) for corn meal substitutions.

Concerning the improvers (pectin and CMC), data indicated that, adding 1% pectin or CMC to barley flour or corn meal increase the absorption of water and units of weakening, meanwhile, decrease the time of stability.

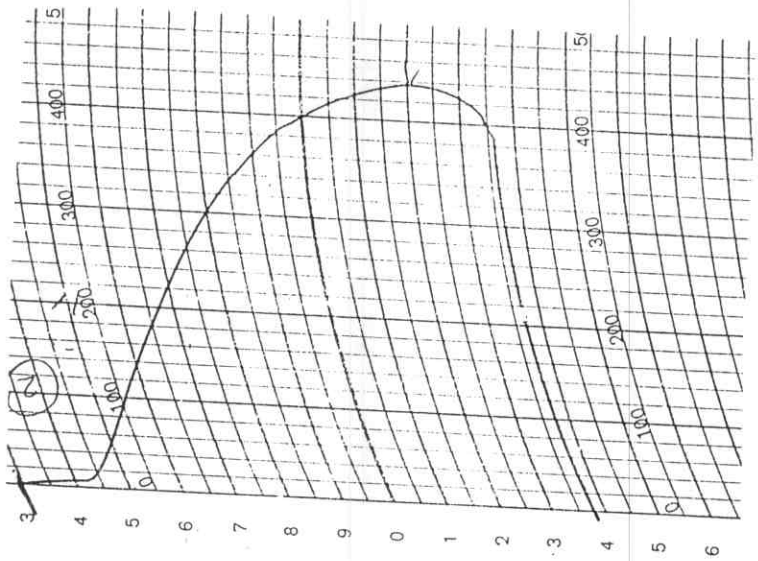
These data agree with **Brys and Zabik (1976)** as they reported that, increase in replacement of flour with cellulose

Table (14) : Effect of substitution of wheat flour with some cereal flours and improvers on the extensogram parameter

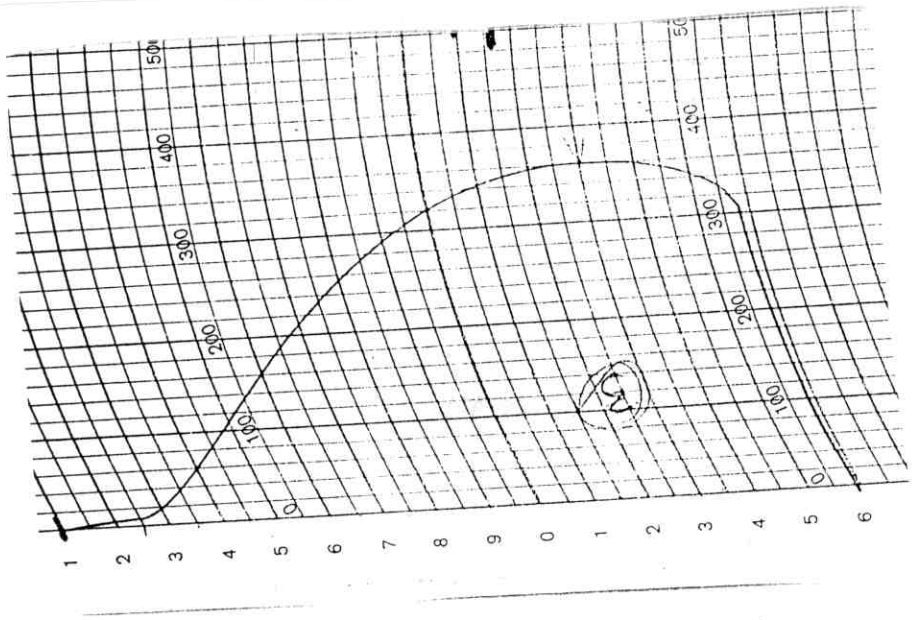
Raw materials	Extensibility mm E	Resistance B.u R	R/E	Energy Cm^2
100% w.f	143	290	2.03	43
5% b.f.+ 95% w.f	95	440	4.63	53
10% b.f. +90% w.f	134	360	2.7	47
20% b.f. +80% w.f	144	245	1.7	32
5% b.f. +1% CMC+ 95% w.f	117	380	3.2	50
5% b.f+1% pectin+ 95% w.f	124	395	3.2	50
5% c.m +95% w.f	128	260	2.1	30
10% c.m+90% w.f	120	245	2.1	33
20% c.m+80% w.f	134	350	2.6	44
5% c.m+1% pectin+ 95% w.f	135	375	2.8	48
5% c.m+1% CMC + 95% w.f	130	185	1.4	27



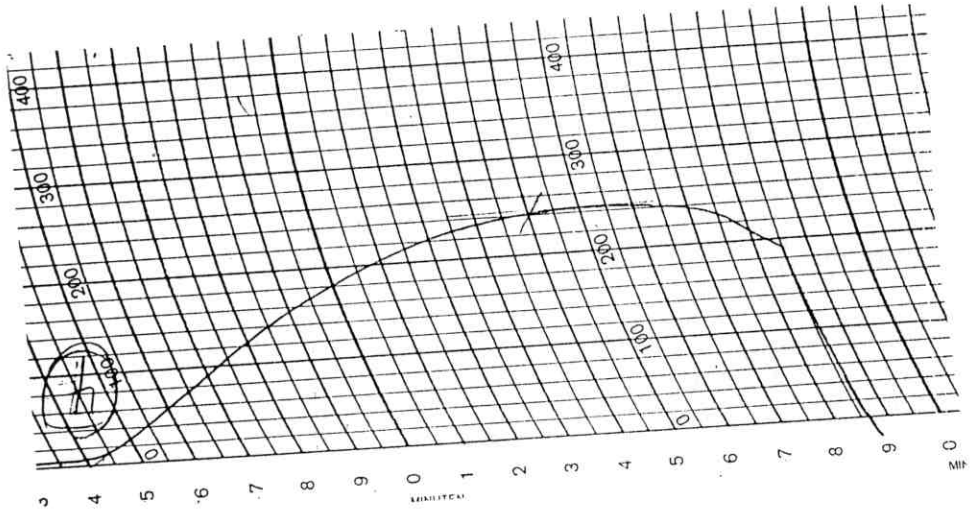
Control 100%W.F 72% extraction



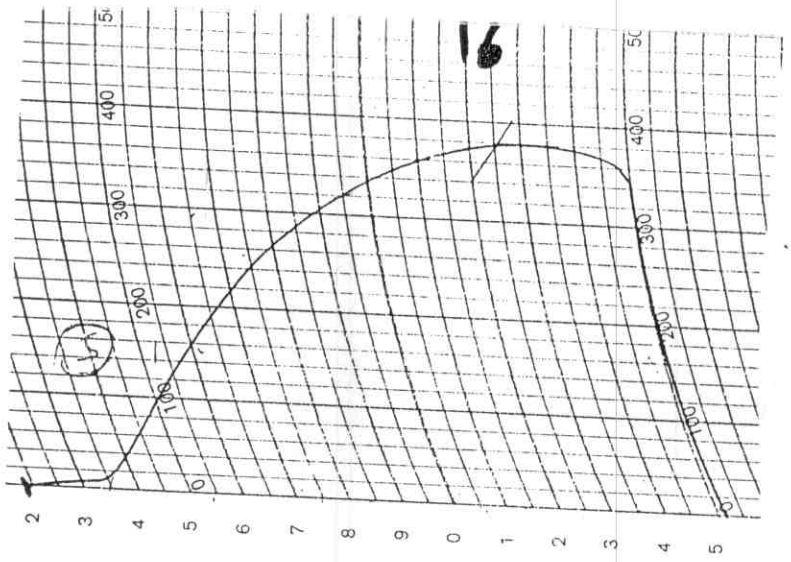
5% Barley flour + 95% W.F 72% extraction



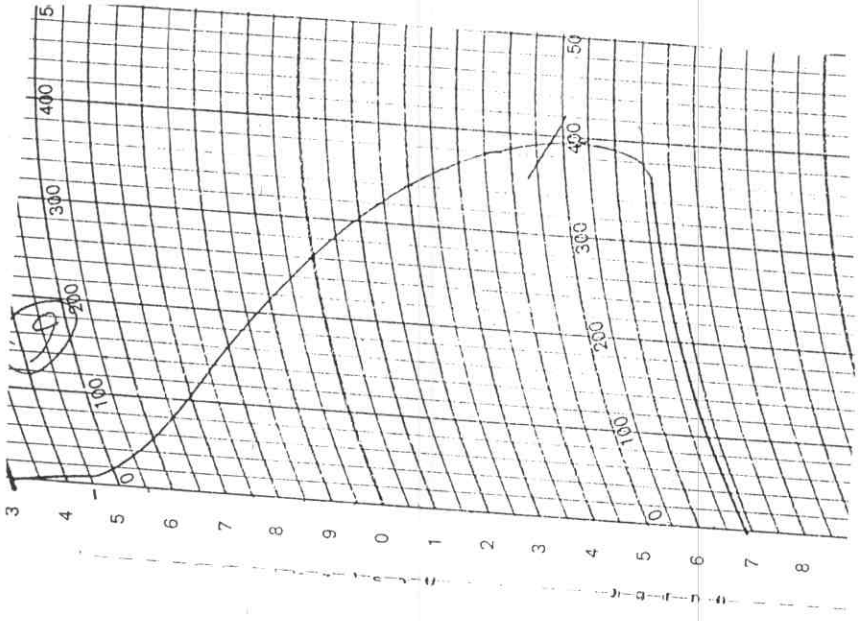
10% Barley flour + 90% W.F 72% extraction



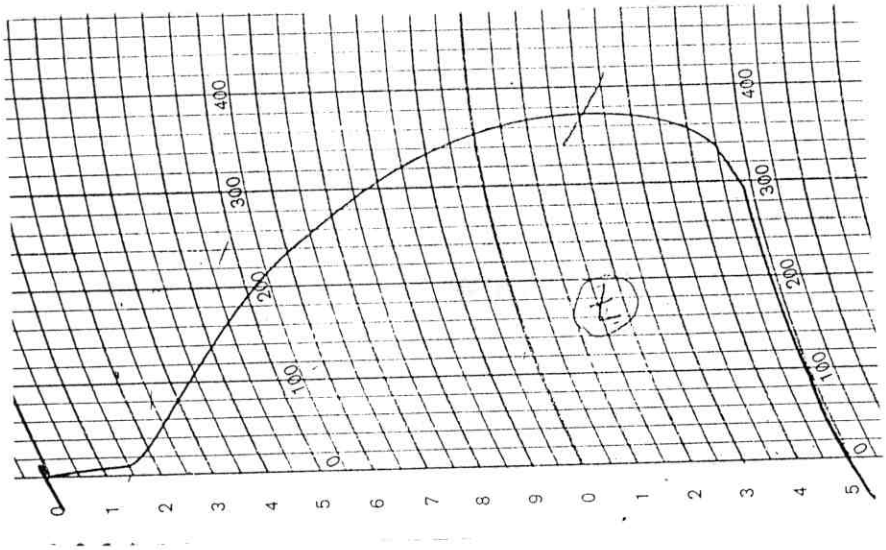
20% corn meal + 80% W.F. 72% extraction



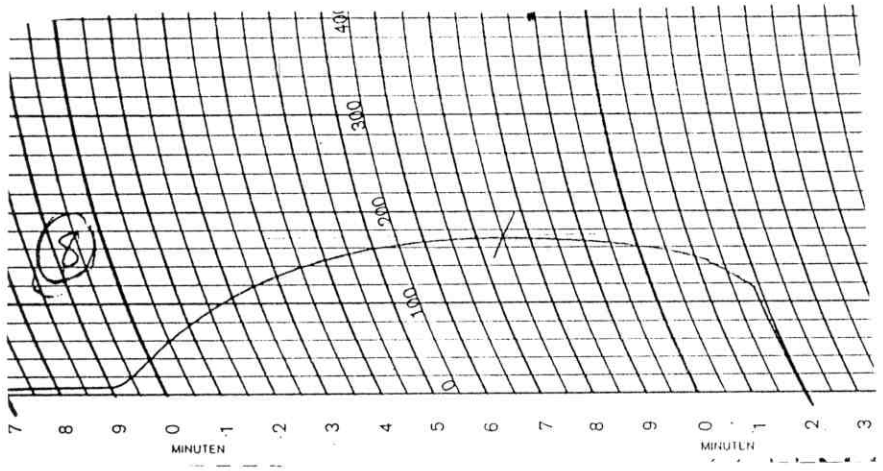
5% corn meal + 1% CMC + 95% W.F. 72% extraction



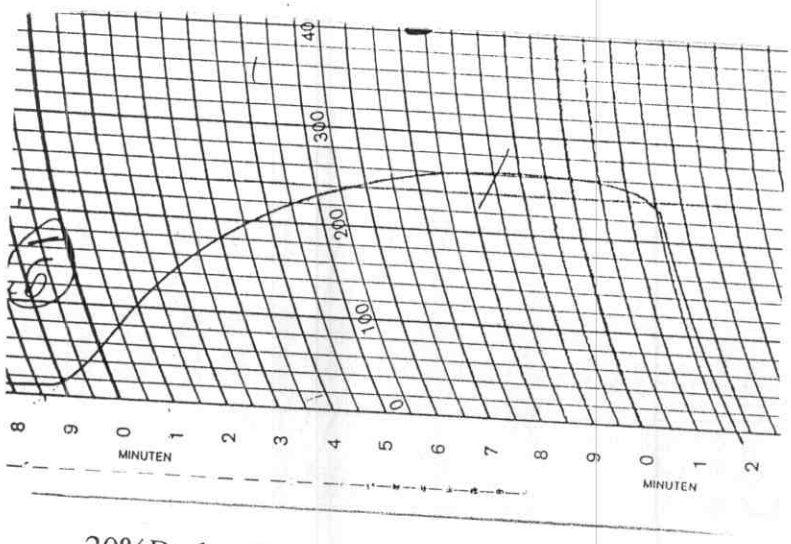
5%Barley flour + 1% pectin + 95% W.F 72% extraction



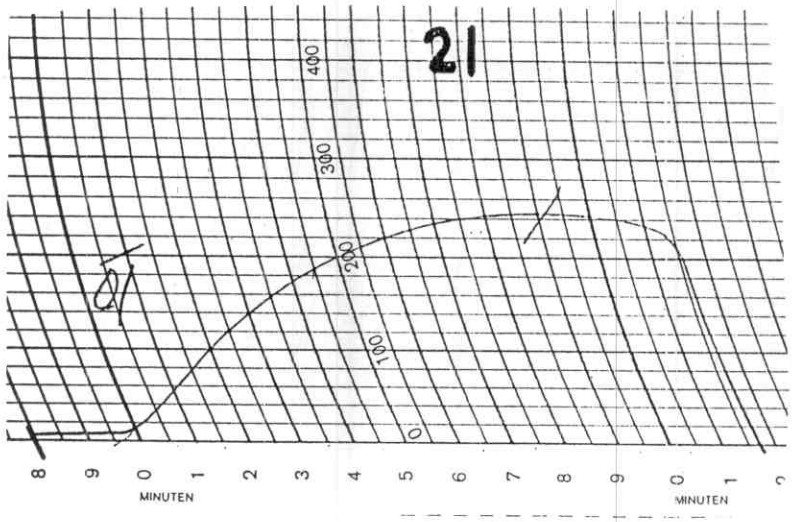
5% corn meal + 95 W.F 72% extraction



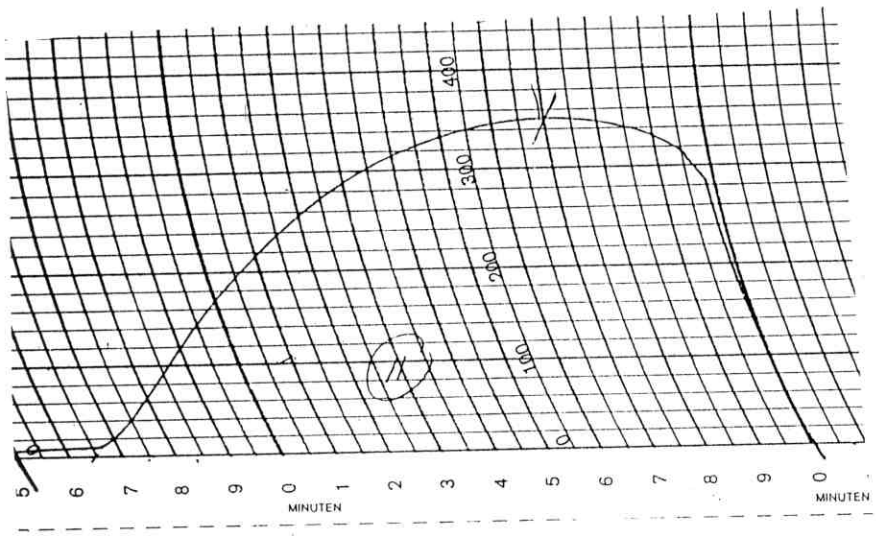
10% corn meal + 90% W.F. extraction



20%Barley flour + 80% W.F 72% extraction



5% corn meal + 1% pectin + 95% W.F 72% extraction



5%Barley flour + 1% CMC + 95% W.F 72% extraction

should weaken the gluten matrix responsible for retaining the leavening gases.

Dealing with Table (14) and Figs (11-22) (extensograms), data showed that, control 100% wheat flour 72% extraction was the highest extensibility (mm). Meanwhile, 5% barley flour plus 1% CMC had the lowest value of extensibility (mm). While, 5% barley flour plus pectin increased slightly the extensibility.

On the other hand, 5% corn meal plus 1% CMC decreased value of extensibility compared to 5% corn meal plus pectin.

Meanwhile, 5% barley flour was the highest value of resistance (B.U.), whereas, 5% corn meal plus 1% CMC were the lowest value of resistance.

The data agree with **Irvine *et al.*, (1960)** who reported that, as grade decreases, dough development time increases and tolerance index decreases slightly. Also, increased absorption. Furthermore, they suggested that, while absorption increases, dough development time decreases, maximum consistency decreases, and tolerance index does not change significantly.

4.5.1 Effect of adding different improvers on cake staling

Alkaline water retention capacity (AWRC) could be useful to follow up staling and shelf life (**Hassan *et al.*, 1990**).

Results obtained from Table (15) revealed that, there was a gradual decrease in AWRC values during room temperature storage of butter cakes.

Table (15) : Effect of adding improvers on butter cake staling

	Control		Butter cake + Pectin		Butter cake + Lecithin		Butter cake + CMC	
	P.u	A%	P.u	A%	P.u	A%	P.u	A%
Zero	155	320	170	355	175	350	180	340
3 days	200	240	235	280	240	275	245	273
6 days	490	130	500	110	505	110	510	105

A% : Alkaline water retention capacity

P.u : Penetrometer reading units (gm/cm^2)

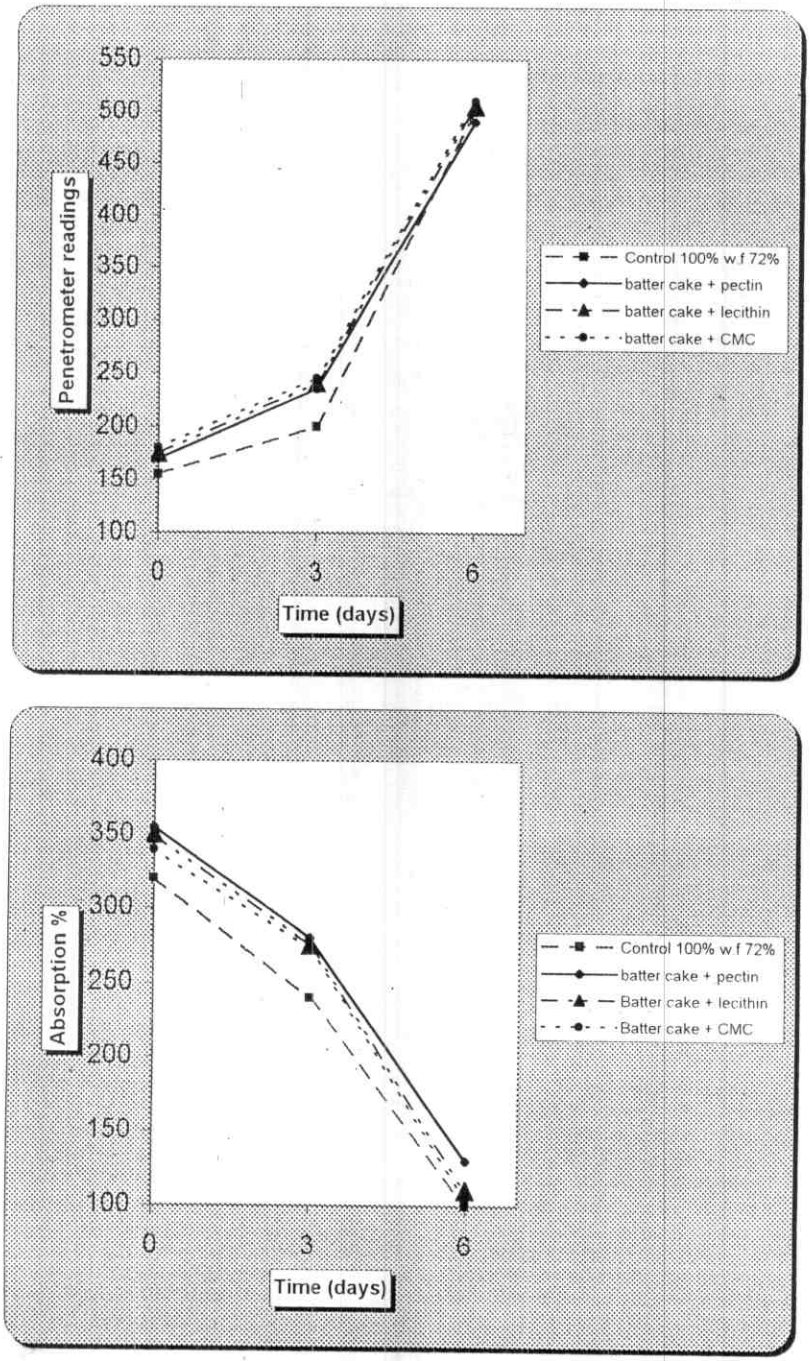


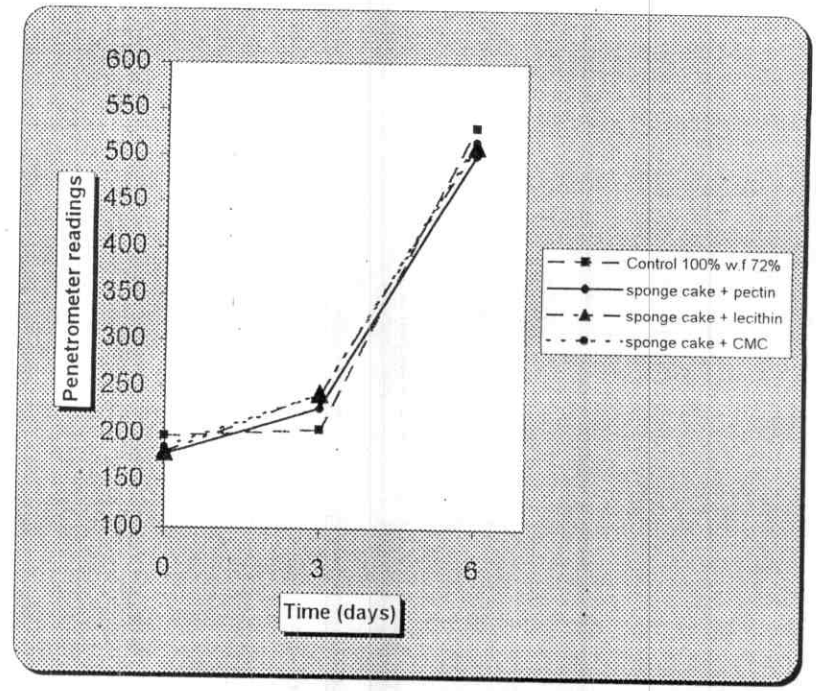
Fig. (23): Effect of adding improvers on staling of butter cakes

Table (16) : Effect of adding improvers on sponge cake staling

	Control		sponge cake + Pectin		sponge cake + Lecithin		sponge cake + CMC	
	P.u	A%	P.u	A%	P.u	A%	P.u	A%
Zero	198	315	178	345	180	340	185	335
3 days	205	235	228	270	243	250	243	250
6 days	490	120	500	110	510	105	515	103

A% : Alkaline water retention capacity

P.u : Penetrometer reading units (gm/cm^2)



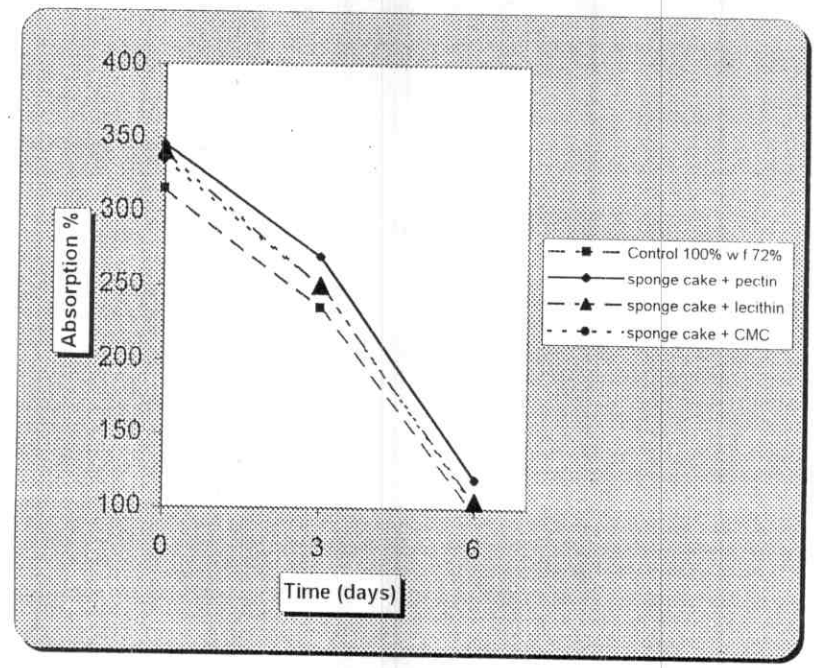


Fig. (24): Effect of adding improvers on staling of sponge cakes

Generally, the higher ratios of AWRC at zero time were in butter cake plus 1% pectin as improver than in butter cake plus lecithin, butter cake plus CMC, and control without improvers.

These results agree with **Mettler and Seipel (1993)** who found that, wheat flour dough, and whole wheat bread had been significantly affected by emulsifiers and hydrocolloids.

Dealing with readings of penetrometer instrument, data indicated that, when the AWRC% decreased, penetrometer reading increased.

Dealing with data illustrated in Table (16), data indicated that, sponge cake with pectin had the highest ratios of AWRC% as indication of softness. Also, the penetrometer readings decreased when AWRC% increased.

These results agree with **Klavones and Bennett (1995)** who reported that, pectin was a polymer of partially methoxylated α-1-4 linked D-galacturonic acid interupted by dispersed 1, 2 linked L-rhamnose unit, which were subsequently linked to neutral sugars. Also, pectin has ability to form gel characteristics structural features. These results are in agreement with those obtained by **Bratzler (1932)** ho reported that, penetrometer reading related more closely to the softness or hardness.

Regarding to Table (17) butter cake with pectin, data revealed that AWRC% in control plus pectin was the highest ratio, at zero time, after 3 days, and after 6 days.

Table (17) : Effect of adding pectin on butter cakes staling substituted with corn meal or barley flour

periods	Control		Pectin 1%											
			Corn meal						Barley flour					
			5%		10%		20%		5%		10%		20%	
	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%
Zero	170	355	180	340	190	325	200	310	190	325	205	310	210	300
3 days	235	280	250	260	260	245	275	230	260	250	275	230	280	195
6 days	490	130	500	120	510	105	520	100	510	105	520	100	530	99

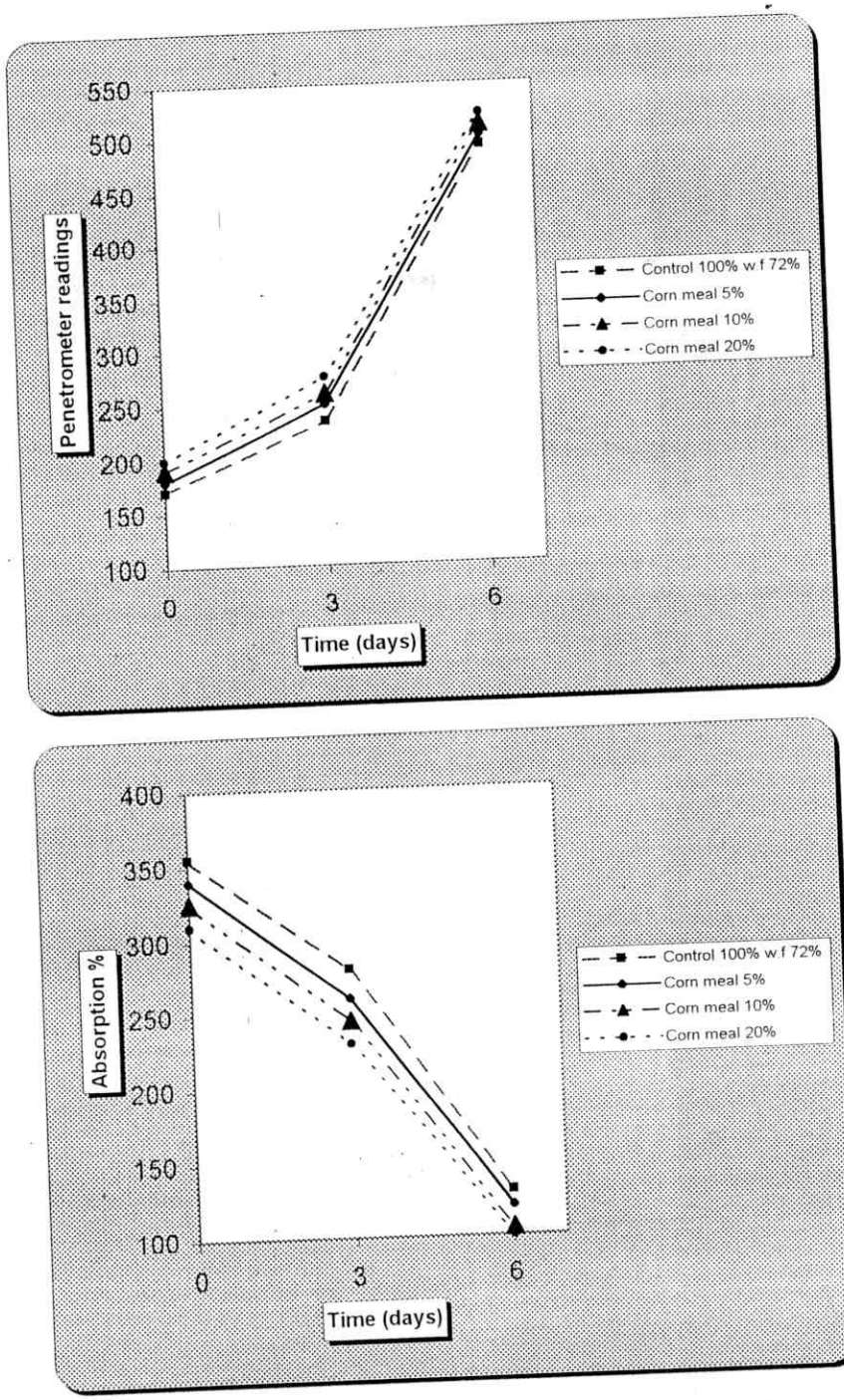


Fig. (25): Effect of adding pectin on butter cakes staling

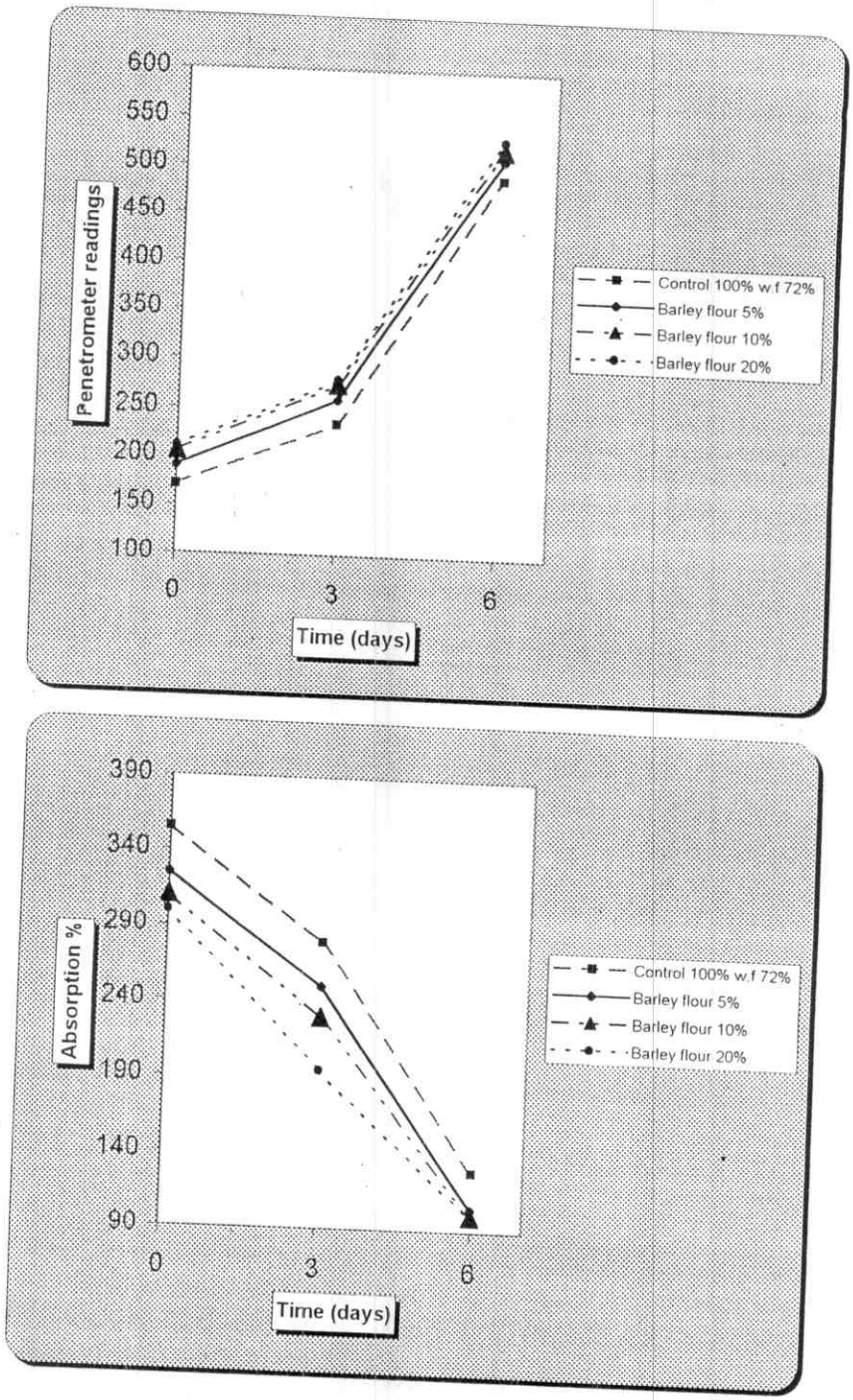


Fig. (26): Effect of adding pectin on butter cake staling

Meanwhile, AWRC% was gradually decreased with corn meal substitutions (5, 10 and 20%), respectively. Also, from the same table, data indicated that, AWRC% of 5% barley flour substitution was decreased compared to 5% corn meal.

On the other hand, AWRC% of 10, and 20% barley flour substitutions, respectively, were slightly decreased compared to 10, and 20% corn meal. This may be due to the ratio of fiber.

These data are in the same line with those obtained by **Zabik *et al.*, (1977)** who suggested adding pectin to the bread to improve the staling leading to increase water holding capacity with increasing concentration of pectin.

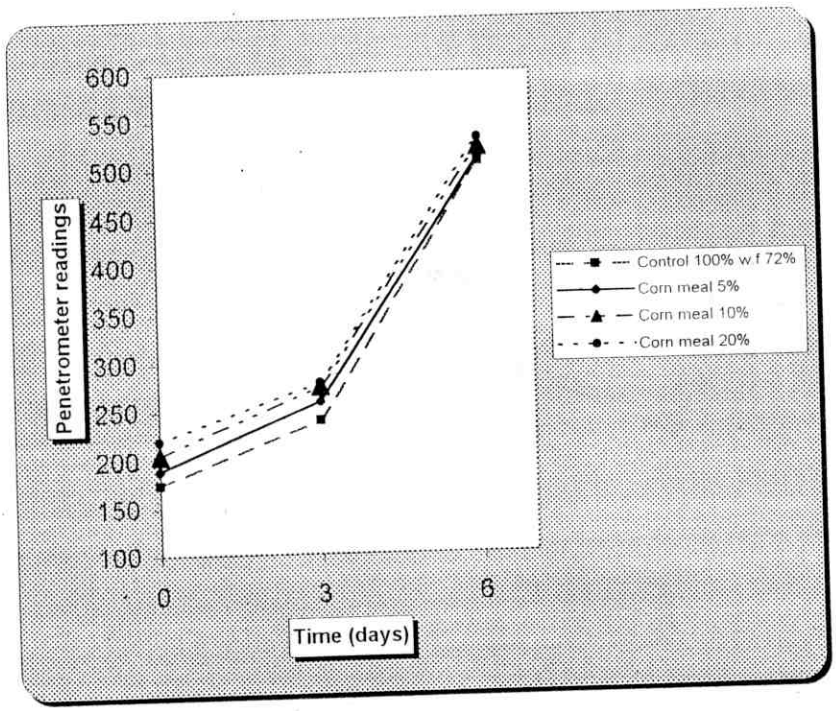
Also, in the same table, data indicated that, at zero time, penetrometer readings were the lowest compared to the intervals after 3 days, and 6 days. Meanwhile, AWRC% were decreased gradually after 3 days, and 6 days. Thus, reading of penetrometer indicated the softness of cake produced as control or other treatments with different ratios of substitutions. Meanwhile, AWRC% decreased gradually indicated to hardness and changed the starch properties. These data are compatible with what was noticed by **Bratzler (1932)** who studied the breaking strength of crisp baked foods or cake.

Regarding data in Table (18), it could be revealed that, control treatment with lecithin 1% had the highest ratios of AWRC% compared to other treatments with different ratios of different substitutions in butter cakes.

Also, at zero time, data showed slight decrease from 5%, 10%, and 20% corn meal, and barley flour substitutions separately, respectively. On the other hand, AWRC% for barley

Table (18) : Effect of adding lecithin on butter cake staling substituted with corn meal or barley flour

periods	Control		Lecithin 1%											
			Corn meal						Barley flour					
			5%		10%		20%		5%		10%		20%	
	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P.u	A%	P.u	A%
Zero	175	350	190	322	205	310	220	300	205	310	220	300	225	290
3 days	240	275	260	245	275	230	280	195	275	230	280	195	283	190
6 days	505	110	510	105	520	100	530	99	520	100	530	99	543	93



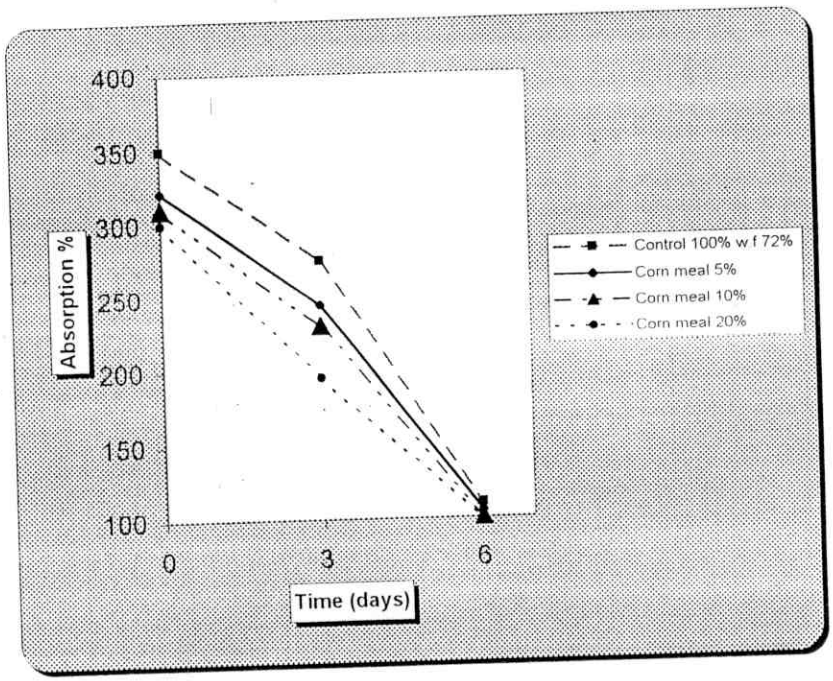


Fig. (27): Effect of adding lecithin on butter cake staling

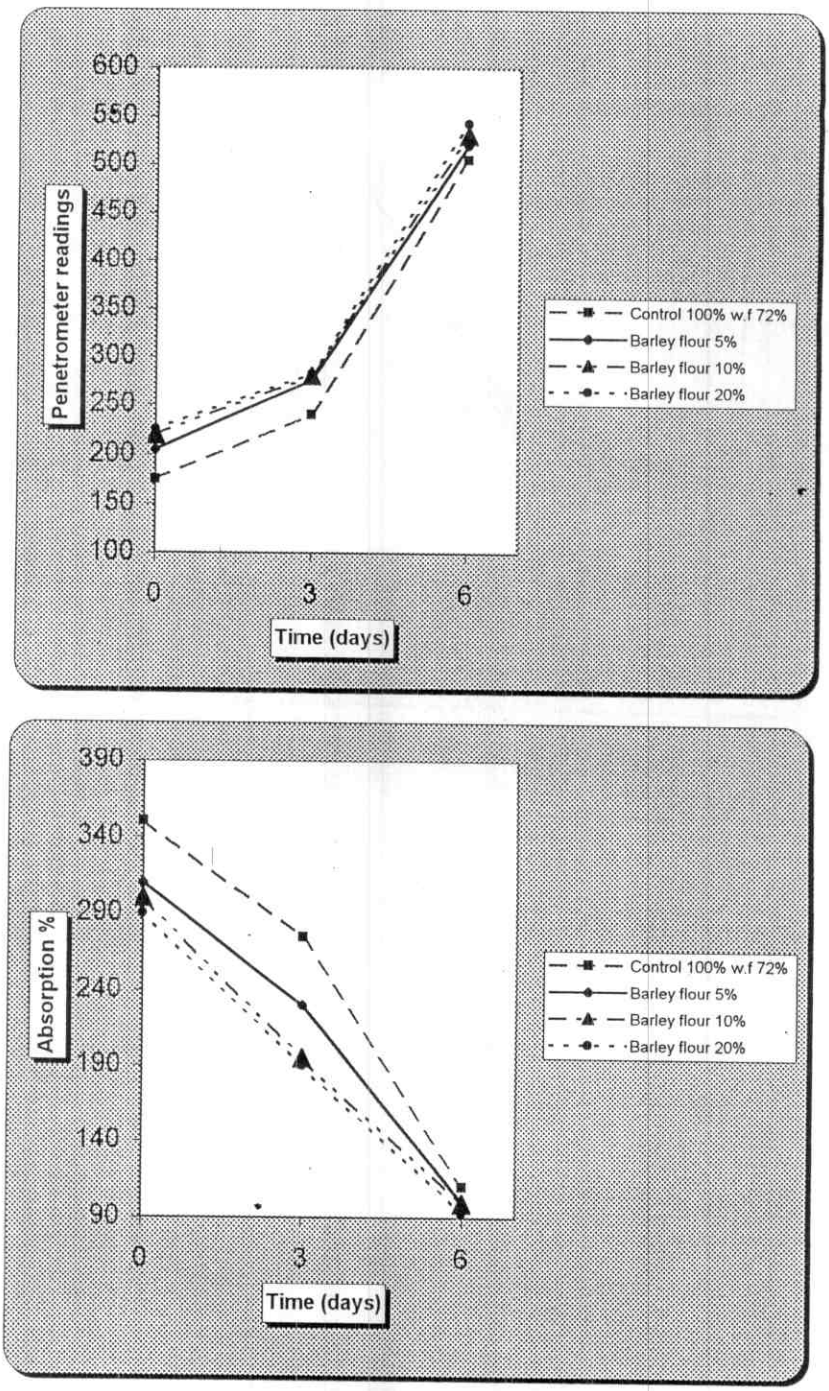


Fig. (28): Effect of adding lecithin on butter cakes staling

flour substitutions were decreased compared to AWRC% for corn meal substitutions. Concerning the penetrometer readings, it was noticed that, it increased from zero time to 6 days after baking, compared with control.

Also, penetrometer readings of 5, 10, and 20% corn meal or barley flour substitutions were increased gradually. These results agree with **Stampfli *et al.*, (1996)** who studied the effects of different emulsifiers such as lecithin, he reported that, it could reduce the strengthening.

Data in Table (19) for butter cake produced with CMC 1% as improver to 5, 10 and 20% substitutions corn meal, and barley flour, respectively, indicated that, control with 1% CMC had the highest ratio of AWRC%. On the other hand, AWRC% was reduced gradually in 5, 10 and 20% of corn meal, and barley flour at zero time, after 3 days , and 6 days after baking.

Concerning the penetrometer readings, data showed that, it increased gradually in the same treatment from zero time to 6 days after baking.

These data are confirmed by those obtained by **Melter and Seipel (1993)** who studied the impact of improvers on whole wheat bread. Also, agree with **Rhee *et al.*, (1983)**, as they found that, mixed naked barley flour, plus wheat flour with different ratios and added gluten, CMC increased loaf volume.

Dealing with Table (20) for sponge cake produced from adding pectin 1% as improver to different substitutions of corn meal and barley flour to wheat flour 72% extraction, data indicated that, control 100% wheat flour 72% extraction had the highest ratio of AWRC, meanwhile, AWRC% was decreased

Table (19) : Effect of adding CMC on butter cake staling substituted with corn meal or barley flour

periods	Control		CMC 1%											
			Corn meal						Barley flour					
			5%		10%		20%		5%		10%		20%	
	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P.u	A%	P.u	A%
Zero	180	340	200	320	220	300	238	285	220	300	225	290	240	280
3 days	245	273	265	240	300	220	310	210	255	220	283	190	295	180
6 days	510	105	520	100	530	98	532	95	530	95	543	93	545	90

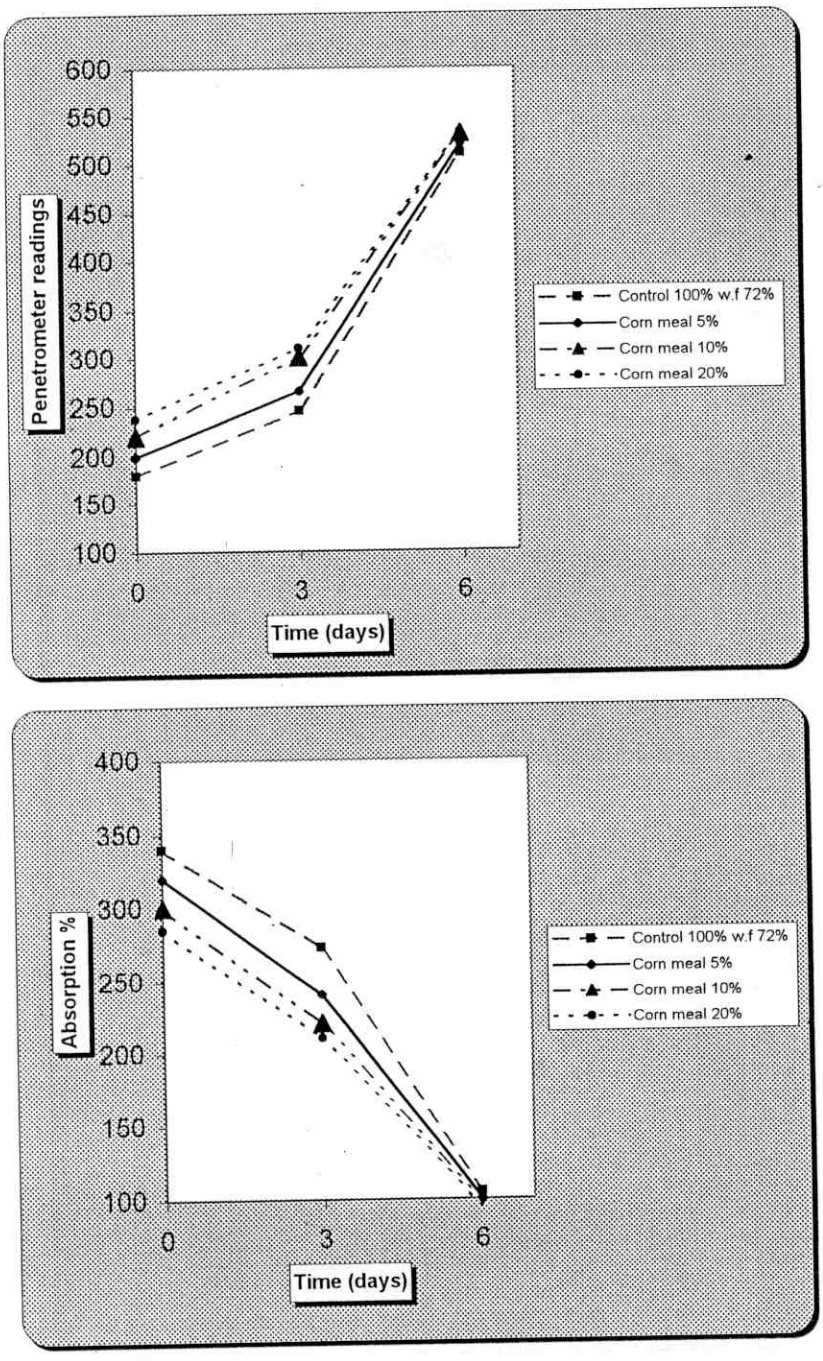
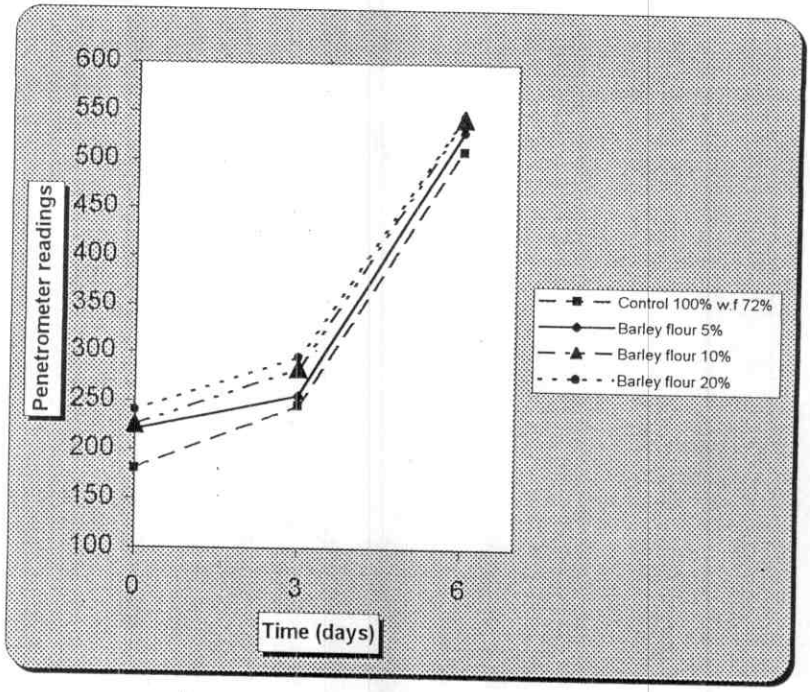


Fig. (29): Effect of adding CMC on butter cakes staling



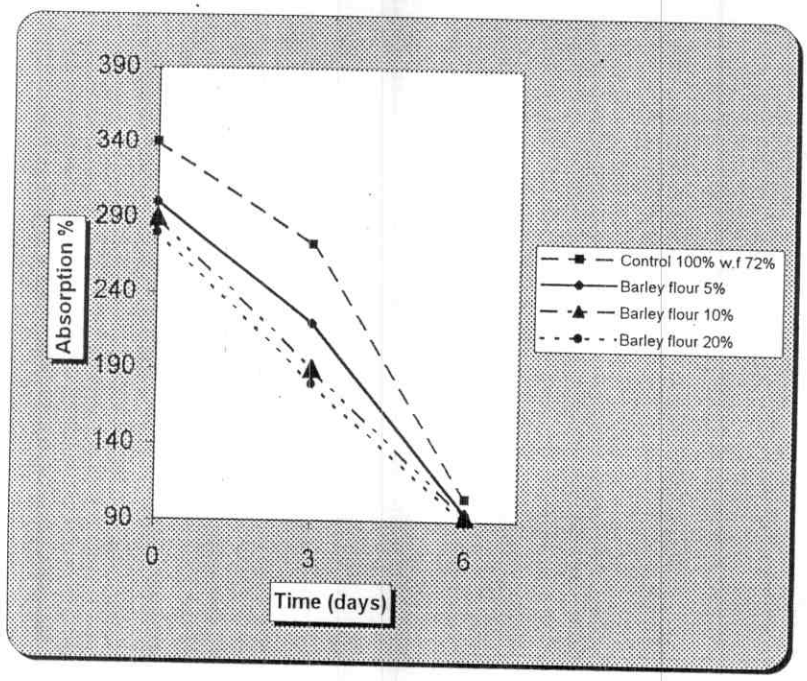
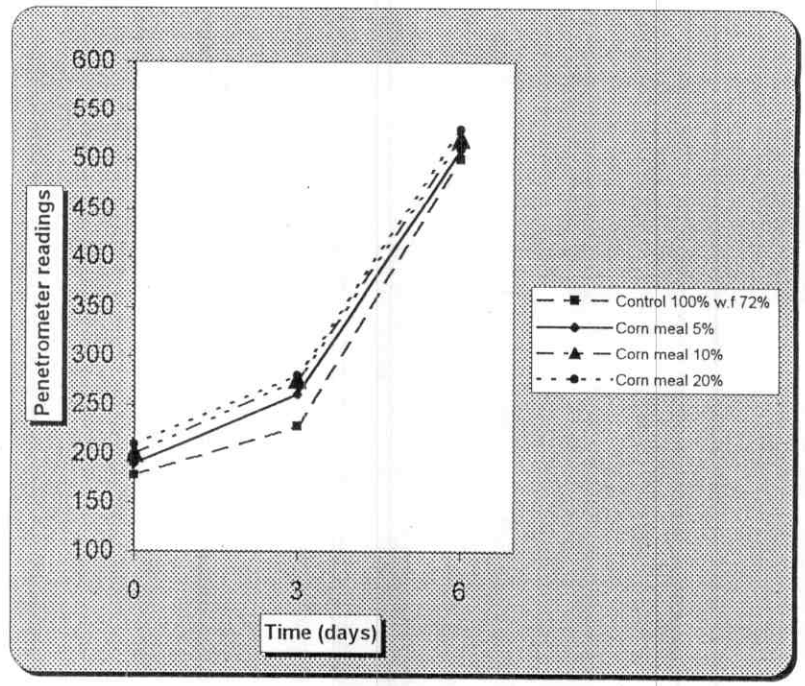


Fig. (30): Effect of adding CMC on butter cakes staling

Table (20) : Effect of adding pectin sponge cake staling substituted with corn meal or barley flour

periods	Control		Pectin 1%											
			Corn meal						Barley flour					
			5%		10%		20%		5%		10%		20%	
	P.u	A%	P. u	A%	P .u	A%	P .u	A%	P .u	A%	P.u	A%	P.u	A%
Zero	178	345	190	325	200	310	210	300	200	310	210	300	215	295
3 days	228	270	260	245	275	230	280	195	275	230	280	195	290	190
6 days	500	120	510	105	520	100	530	99	520	100	530	99	535	95



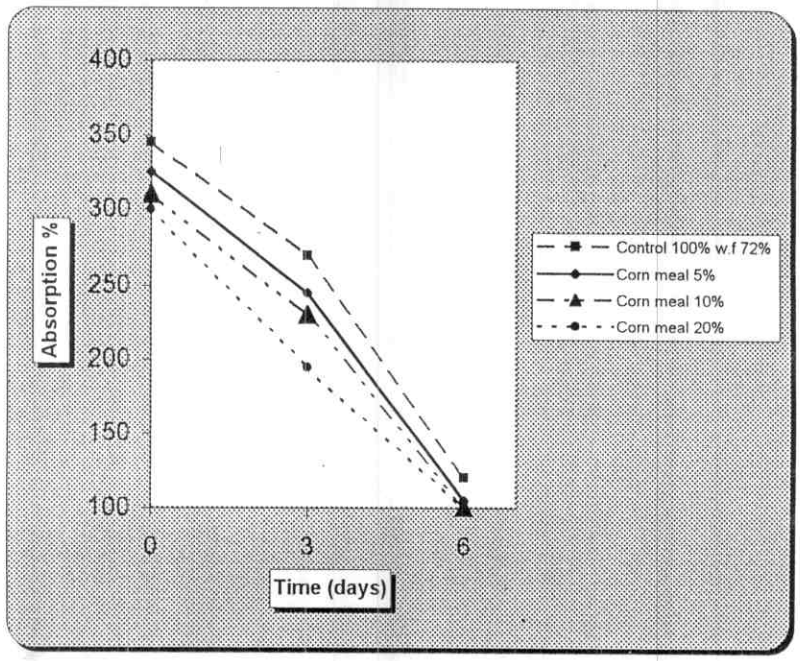
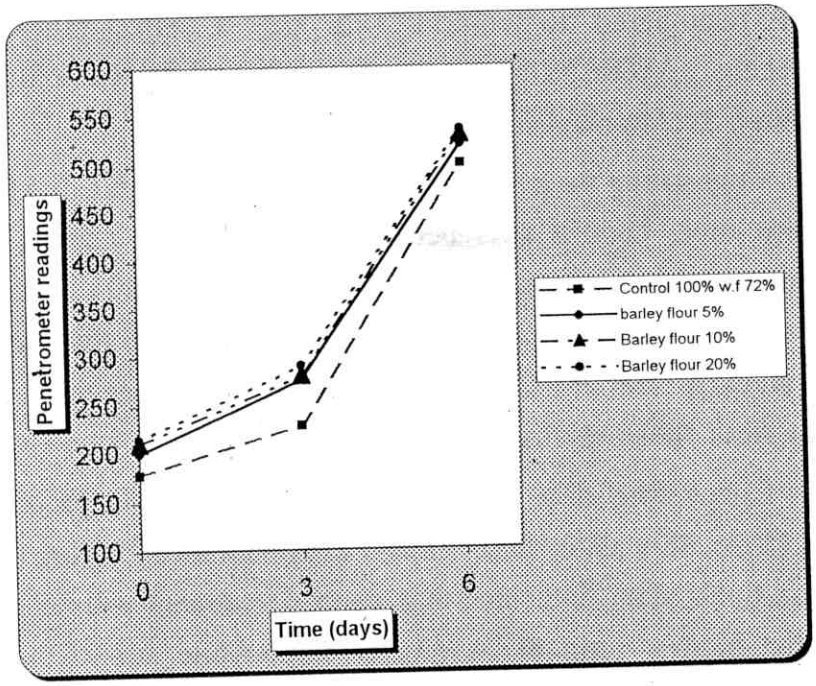


Fig. (31): Effect of adding pectin on sponge cakes staling



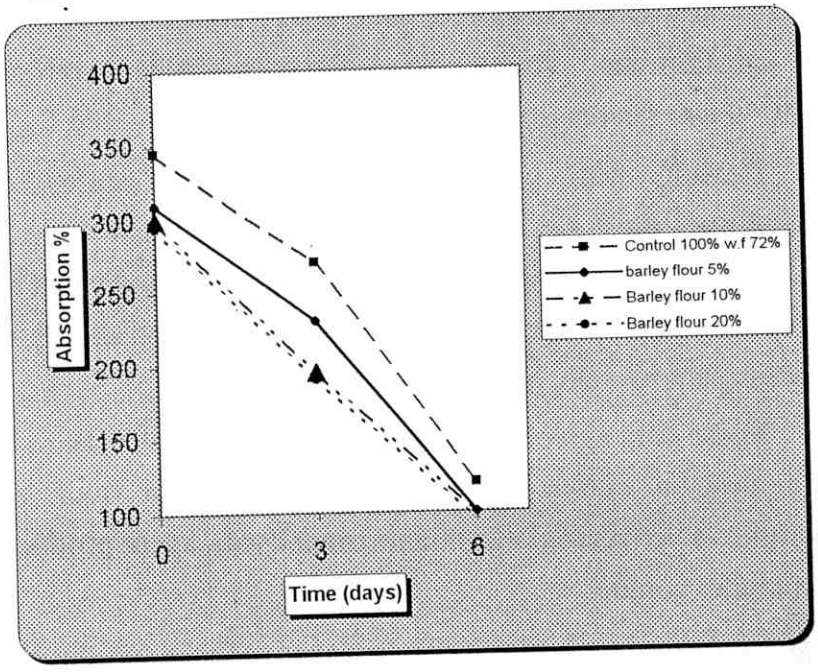


Fig. (32): Effect of adding pectin on sponge cakes staling

slightly compared to control with pectin, also, ratios of decreasing AWRC% of barley flour substitutions were higher compared to corn meal substitutions.

Concerning the penetrometer readings, data indicated that, at zero time, control plus pectin had the lowest reading for control treatment, meanwhile, after 3 days, and 6 days, readings increased. Also, for readings of penetrometer for all treatments, data showed that, it increased for 5, 10 and 20% corn meal, and barley flour substitutions.

Concerning data in Table (21) for sponge cake produced from 1% lecithin added to 5, 10, and 20% corn meal, barley flour substitutions, data indicated that, control treatment with lecithin had the highest ratio of AWRC%. Meanwhile, AWRC% was gradually decreased in 5, 10, and 20% corn meal and barley flour substitutions. Also, after 3 days and 6 days of baking, AWRC% was decreased.

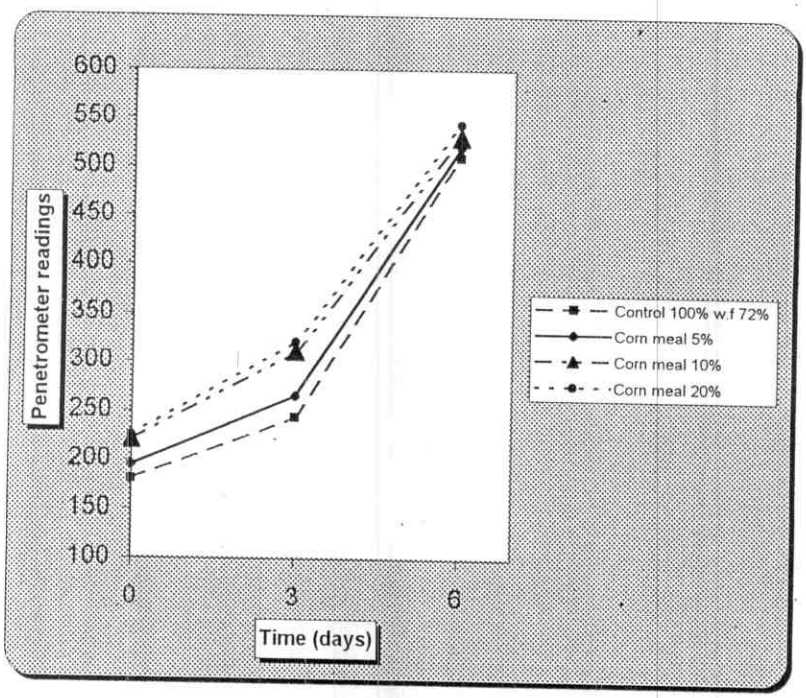
Dealing with penetrometer readings, it increased in substitutions, thus, penetrometer readings increased from zero time, after 3 days, and after 6 days. These data indicated from control without improvers that, lecithin 1% added as an improver may cause tender cake produced.

These data agree with **Jewell and Seaman (1994)**, as they found that, a cookie dough comprising wheat flour, a fat substitute, a leavening agent, and emulsifying agent produced a moist tender cookie.

Concerning Table (22) for sponge cake produced by adding 1% CMC as improver to 5, 10, and 20% substitutions corn meal and barley flour, respectively, data showed that,

Table (21) : Effect of adding lecithin on sponge cake staling substituted with corn meal or barley flour

periods	Control		Lecithin 1%											
			Corn meal						Barley flour					
			5%		10%		20%		5%		10%		20%	
	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P.u	A%	P.u	A%
Zero	180	340	195	320	220	300	225	290	220	300	225	290	240	280
3 days	243	250	265	240	310	210	320	190	283	210	295	190	310	180
6 days	510	105	520	100	530	95	543	93	530	95	543	93	545	90



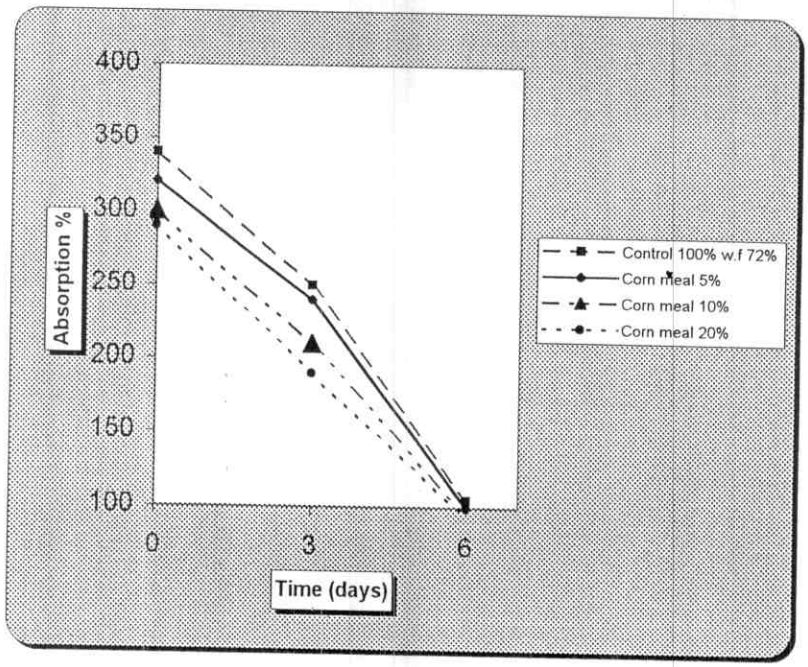
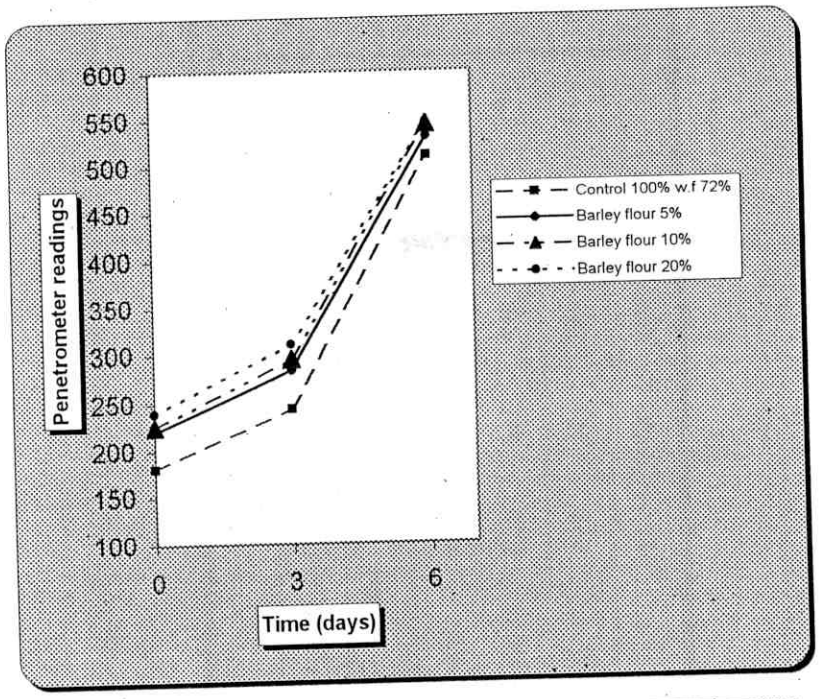


Fig. (33): Effect of adding lecithin on sponge cakes staling



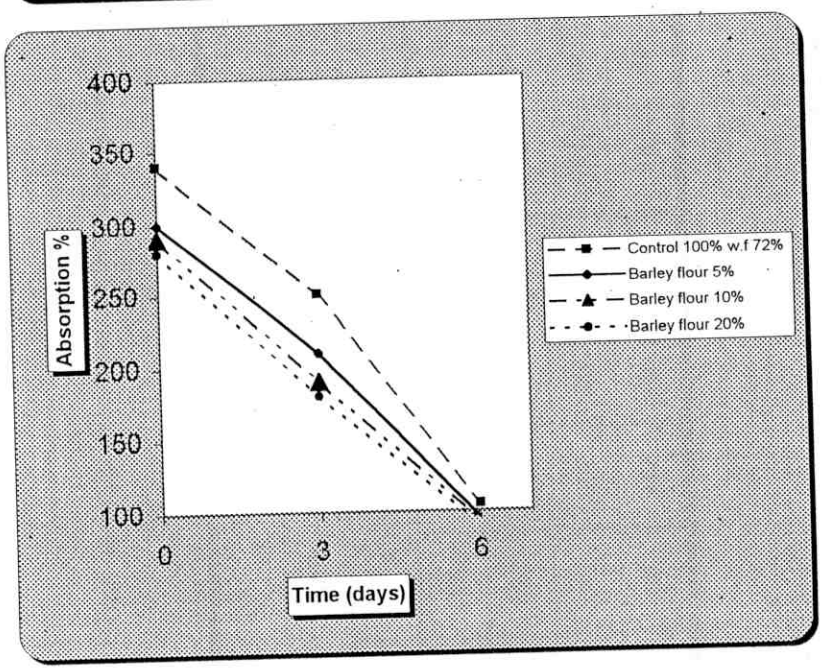
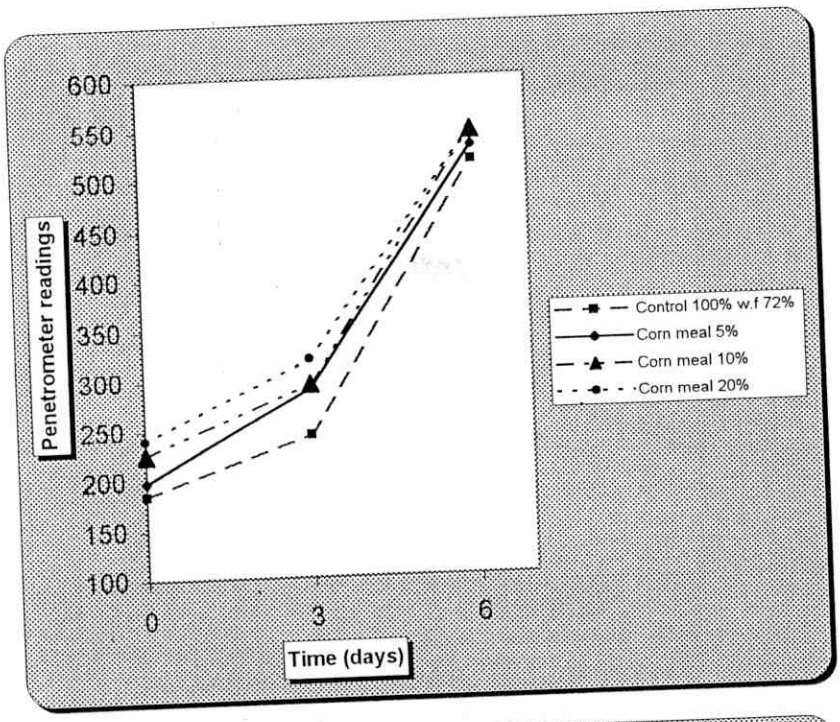


Fig. (34): Effect of adding lecithin on sponge cakes staling

Table (22) : Effect of adding CMC on sponge cake staling substituted with corn meal or barley flour

periods	Control		CMC 1%											
			Corn meal						Barley flour					
			5%		10%		20%		5%		10%		20%	
	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P .u	A%	P.u	A%	P.u	A%
Zero	185	335	198	315	225	290	240	280	225	290	238	283	245	275
3 days	243	250	290	230	295	200	320	180	290	200	300	185	320	175
6 days	515	103	530	98	545	90	546	89	540	90	545	90	548	87



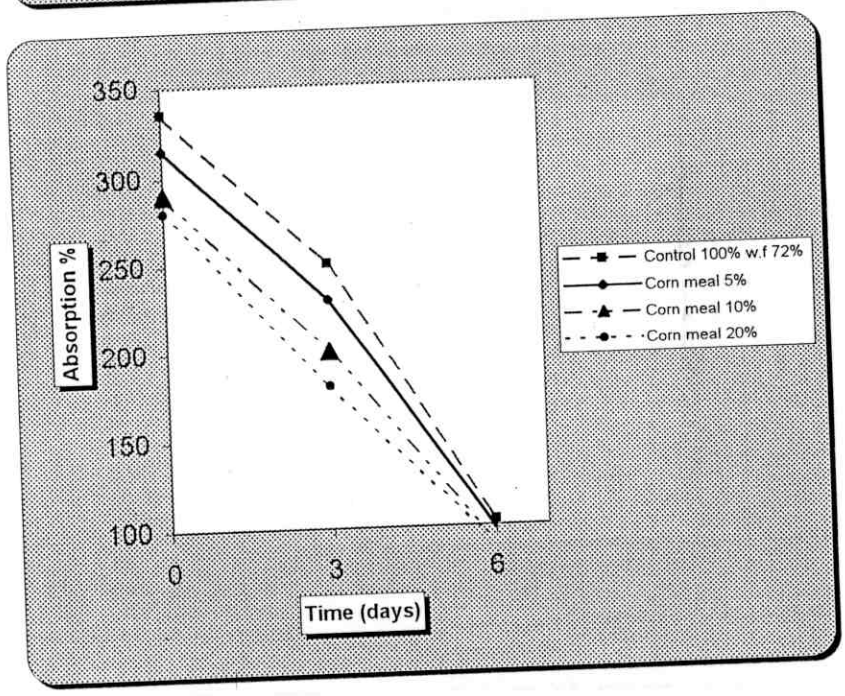


Fig. (35): Effect of adding CMC on sponge cakes staling

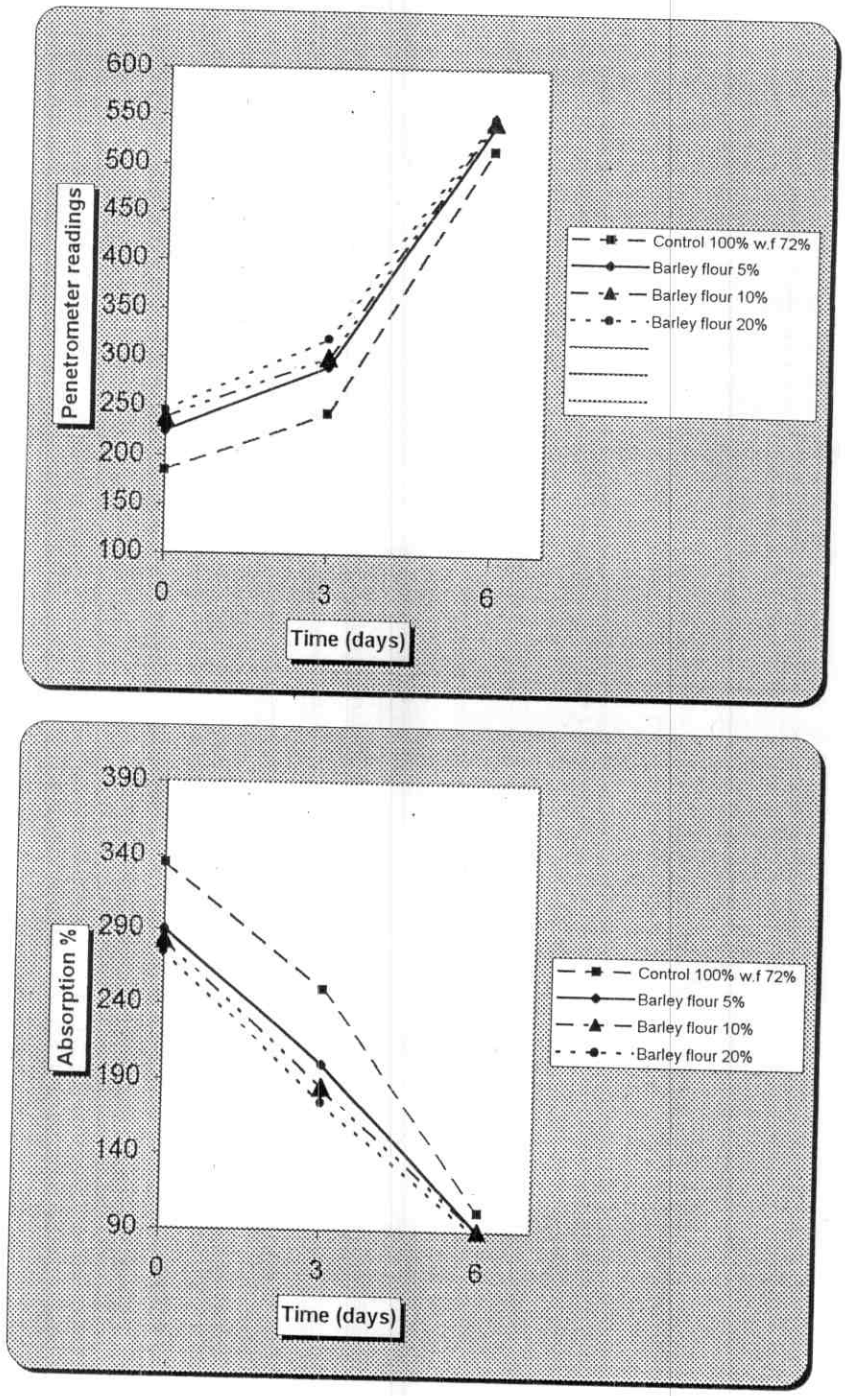


Fig. (36): Effect of adding CMC on sponge cakes staling

control treatment plus 1% CMC had the highest ratio of AWRC%. Meanwhile, AWRC% decreased gradually from 5, 10 to 20% corn meal. Also, AWRC% was slightly decreased from 5, 10 and 20% barley flour compared to 5, 10, and 20% corn meal. Concerning the penetrometer readings, it increased from zero time, 3 days after baking, and 6 days after baking.

4.6 Organoleptic properties :

4.6.1 Organoleptic properties of butter cakes with improvers (pectin, lecithin, and CMC) :

Concerning data showed in Table (23), it indicated that, there were no significant differences among all treatments as control (100% W.F) without improver, butter cakes + pectin 1%, butter cakes + lecithin 1%, and butter cakes + CMC 1% for texture score from statistical results. On the other hand, there were significant differences among control, butter cakes with pectin, and butter cakes with lecithin, and butter cakes with CMC for crust color scores.

Whereas, there were non significant differences between control, and butter cakes with pectin for taste score.

Also, there were significant differences between butter cakes with lecithin, and butter cakes with carboxy methyl cellulose. Regarding the shape score in the same table, data indicated that, there were no significant differences between control without improvers, and butter cakes with pectin. Also, butter cakes with lecithin, and butter cakes with carboxy methyl cellulose.

Table (23) : Organoleptic properties of butter cakes with/without improvers

Treatments	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Control 100% w.f	19.51 a	19.90 a	19.80 a	19.90 a	19.90 a	99.00 a
Butter cake + pectin 1%	19.60 a	19.90 a	19.80 a	19.90 a	19.80 a	99.00 a
Butter cake + lecithin 1%	19.50 a	19.30 b	19.50 b	19.60 b	19.50 a	97.40 b
Butter cake + CMC 1%	19.20 a	19.20 a	19.00 c	19.60 c	19.60 b	96.60 c

Means followed by the same letter (s) within each column are not significantly different at 5% level.

On the other hand, overall acceptability score in the same table showed that, there were significant differences among control, butter cakes with pectin, and butter cakes with lecithin, and butter cakes with CMC.

4.6.2 Organoleptic properties of sponge cakes with improvers :

Concerning the data showed in Table (24), there were no significant differences between control without improver, and sponge cakes with pectin. Also, between sponge cakes with pectin, and sponge cakes with lecithin, for texture score of sponge cakes.

On the other hand, there were no significant differences between control, and sponge cakes with pectin in the same table.

Regarding the taste score, data indicated that, there were significant differences between sponge cakes with lecithin, sponge cakes with CMC, and sponge cakes with pectin and control without improver.

Also, in the same table, odor score revealed that, there were no significant differences between control, and sponge cakes with pectin. Also, between sponge cakes with lecithin, and sponge cakes with carboxy methyl cellulose. Dealing with overall acceptability score, the statistical results showed that, there were significant differences between control, sponge cakes with pectin, and sponge cakes with lecithin, and sponge cakes with CMC.

Table (24) : Organoleptic properties of sponge cakes with/without improvers

Treatments	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Control 100% w.f	19.60 a	19.80 a	19.90 a	19.90 a	19.80 a	99.00 a
Sponge cake + pectin 1%	19.50 ab	19.70 a	19.90 a	19.90 a	19.80 a	98.80 a
Sponge cake + lecithin 1%	19.45 b	19.40 b	19.60 b	19.00 b	19.00 b	96.45 b
Sponge cake + CMC 1%	19.30 c	19.35 b	19.40 c	18.99 b	18.99 b	96.03 c

CMC presented carboxy methyl cellulose
Means followed by the same letter (s) within each column are not significantly different at 5% level.

Table (25) : Organoleptic properties of butter cakes with pectin

Butter cakes	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Butter cake + pectin	19.60 a	19.90 a	19.80 a	19.90 a	19.80 a	99.00 a
5% c.m + p	18.90 b	19.30 b	19.70 ab	19.60 b	19.70 ab	97.20 b
10% c.m + p	18.70 cd	19.20 bcd	19.00 c	19.00 c	19.60 ab	95.50 c
20% c.m + p	18.50 c	19.10 d	19.00 c	19.95 c	19.50 bc	95.05 d
5% b.f + p	18.80 bc	19.25 bc	19.65 b	19.55 b	19.70 ab	96.95 b
10% b.f + p	18.70 cd	19.10 d	19.00 c	18.99 c	18.99 c	94.78 e
20% b.f + p	18.65 d	19.15 cd	19.00 c	19.00 c	18.55 d	94.35 f

Control = 100% wheat flour 72% extraction
c.m = corn meal
b.f = barley flour
p = pectin
Means followed by the same letter (s) within each column are not significantly different at 5% level.

4.6.3 Organoleptic properties of butter cake with pectin :

Dealing with organoleptic properties test, such as texture, crust color, taste, odor, shape, and overall acceptability. This test was carried out with 10-12 professional panelists of food technology at Food Technology Research Institute (A.R.C).

Data in Table (25) include organoleptic properties of butter cakes with 1% pectin showed that, concerning the texture, control sample had the highest score being 19.60 followed by the sample with 5% corn meal, followed by the sample with 5% barely flour, followed by 10% corn meal, 10% barley flour followed by 20% barley flour and corn meal. Regarding the statistics, data showed that, there were significant differences between control, and all other treatments. Meanwhile, there were no significant differences between 5% corn meal, and 5% barley flour. Also, among 10% corn meal, 10%, and 20% barley flour.

Concerning the crust color for butter cakes with pectin, data showed that, control was the highest score being 19.90 followed by the sample with 5% corn meal, followed by the sample with 5% barley flour, followed by the sample 10% corn meal substitution, 20% barley flour, 20% corn meal, and 10% barley flour, respectively. Statistical analyses, revealed that, there were significant differences between control and all other samples. There were non-significant differences among 5% corn meal, 5% barley flour and 10% corn meal. There were no significant differences among 10% corn meal, 20% barley flour. 10% barley flour, and 20% corn meal.

Table (26) : Organoleptic properties of butter cake with lecithin

Butter cakes	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Butter cake + lecithin	19.50 a	19.30 a	19.50 a	19.60 a	19.50 a	97.40 a
5% corn meal	19.45 b	19.25 ab	19.50 a	19.65 a	19.65 a	97.35 a
10% corn meal	19.40 c	19.15 bc	19.40 a	19.60 a	19.45 a	97.00 abc
20% corn meal	19.30 e	19.10 c	19.40 a	19.60 a	19.40 a	96.80 bc
5% barley flour	19.43 bc	19.20 abc	19.45 a	19.60 a	19.50 a	97.18 ab
10% barley flour	19.35 d	19.15 bc	19.41 a	19.55 a	19.45 a	96.91 bc
20% barley flour	19.25 f	19.10 c	19.35 a	19.50 a	19.40 a	96.60 c

Means followed by the same letter (s) within each column are not significantly different at 5% level.

Concerning taste the data in the same table, showed that, control had the highest score 19.80 followed by 5% corn meal, 5% barley flour, 10% corn meal, 20% corn meal, 10% and 20% barley flour, respectively.

Concerning the overall acceptability score, data showed that, control had the highest score being 99.00 followed by 5% corn meal, 5% barley flour, 10% corn meal, 20% corn meal, 10% barley flour and 20% barley flour, respectively.

4.6.4 Organoleptic properties of butter cake with lecithin

Data in Table (26) show that, the maximum overall acceptability score was found in control and 5% corn meal treatment with lecithin. Concerning the texture score it was 19.50 in control, followed by the treatment with 5% corn meal being 19.45, followed by 5% barley flour being 19.93, followed by 10% corn meal being 19.40, followed by 10% barley flour being 19.35, 20% corn meal, and followed by the treatment with 20% barley flour substitutions.

Also, for statistical analysis, data revealed that, there were significant differences between control and the all treatments. Meanwhile, there were significant differences among treatment with 5% corn meal, 10%, 20% corn meal, 10% barley flour, and 20% barley flour substitutions, respectively.

On the other hand, there were no significant differences between 5% corn meal, and 5% barley flour substitutions. Finally, there were non-significant differences between 10% corn meal, and 5% barley flour. Concerning the crust color of butter cake with lecithin in the same table, data showed that,

control treatment had the highest score being 19.30, followed by 5% corn meal, followed by 5% barley flour, followed by 10% corn meal, barley flour, and followed by 20% corn meal, barley flour substitutions, respectively. Also, from statistical analysis data indicated that, there were significant differences among control treatment, 10%, 20% corn meal, 10%, 20% barley flour substitutions, frequently.

Meanwhile, there were no significant differences among control, 5% corn meal, barley flour. Whereas, there were no significant differences among 5% corn meal, barley flour, 10% corn meal, and barley flour.

Regarding the taste score of butter cakes with lecithin, data revealed that, control treatment had the highest score. Also, from statistic analyses indicated that, there were no significant differences between control and other treatments.

Dealing with odor score, data showed, there were no significant differences between control and other treatments. Also, for shape score, data indicated that there were no significant differences between control and other treatments.

Meanwhile, overall acceptability score indicated that, there were significant differences between control treatment, 10% barley flour, 20% corn meal substitutions, and 20% barley flour, respectively.

On the other hand, there were no significant differences among control, 5% corn meal, 5% barley flour, 10% corn meal substitutions, frequently. It does mean, there were non-significant differences in the shape, odor and taste scores.

Table (27) : Organoleptic properties of butter cake with CMC 1%

Butter cakes	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Butter cakes + CMC	19.20 a	19.20 a	19.00 a	19.60 a	19.60 a	96.60 a
5% corn meal	18.90 b	19.00 b	19.00 a	19.60 a	19.60 a	96.10 b
10% corn meal	18.80 bc	19.00 b	19.00 a	19.50 ab	19.55 a	95.85 bc
20% corn meal	18.70 c	18.99 b	18.99 a	19.40 ab	19.40 b	95.48 d
5% barley flour	18.50 d	18.99 b	19.00 a	19.50 b	19.55 a	95.54 cd
10% barley flour	18.45 d	18.93b	19.00 a	19.40 b	19.55 a	95.33 de
20% barley flour	18.40 d	18.90 b	18.90 a	19.40 b	19.45 ab	95.05 e

Means followed by the same letter (s) within each column are not significantly different at 5% level.

4.6.5 Organoleptic properties of butter cakes with carboxy methyl cellulose 1% :

Concerning the texture score showed in Table (27) indicated that, control treatment had the highest score compared to the other treatments, followed by the treatment with 5%, 10%, 20% corn meal, followed by the sample with 5%, 10% and 20% barley flour, respectively.

Data of statistical analysis showed that, there were significant differences among control treatment, and other treatments. On the other hand, there were non-significant differences between the treatment with 5% corn meal, and 10% corn meal. Also, among 5, 10%, and 20% barley flour.

Dealing with crust color score in the same table, revealed from the data that, there was significant difference between control treatment, and the other treatments. Meanwhile, there were non-significant differences among all treatments except control treatment.

On the other hand, there were no significant differences among control and all treatments of taste score. Whereas, there were significant differences among control, the treatment with 5, 10, and 20% corn meal and 5, 10, and 20% barley flour substitutions of odor score.

Also, there were non-significant differences among control, 5, 10% corn meal, and 5, 10, and 20% barley flour of shape score. On the other hand, there were significant differences among control and other treatments.

Table (28) : Organoleptic properties of sponge cake with pectin

Sponge cakes	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Sponge cakes + pectin	19.50 a	19.70 a	19.90 a	19.90 a	19.80 a	98.80 a
5% corn meal	19.30 b	19.50 b	19.70 b	19.70 b	19.70 ab	97.90 b
10% corn meal	19.10 c	19.30 c	19.95 c	19.40 c	19.50 cd	96.75 c
20% corn meal	18.90 d	19.00 d	19.10 d	19.20 d	19.30 d	95.50 d
5% barley flour	19.25 b	19.50 b	19.65 b	19.60 b	19.60 bc	97.60 b
10% barley flour	19.00 d	19.25 c	19.40 c	19.40 c	19.40 de	96.45 c
20% barley flour	18.90 d	18.90 d	19.00 e	19.10 d	19.25 f	95.15 d

Means followed by the same letter (s) within each column are not significantly different at 5% level.

Control represent 100% wheat flour 72% extraction
5% corn meal represent 5% corn meal + 95% wheat flour
10% corn meal represent 10% corn meal + 90% wheat flour
20% corn meal represent 20% corn meal + 80% wheat flour

5% barley flour meal represent 5% barley flour + 95% wheat flour
10% barley flour represent 10% barley flour + 90% wheat flour
20% barley flour represent 20% barley flour + 80% wheat flour

4.6.6 Organoleptic properties of sponge cakes with pectin

Dealing with data in Table (28), the results showed that, the control had the highest score of texture 19.50, compared to other treatments followed by the sample with 5% corn meal, 55 barley flour, 10% corn meal, 10% barley flour, 20% corn meal, and 20% barley flour substitutions.

Concerning the statistics, data indicated that, there was significant differences between control, and all treatments. Meanwhile, there were no significant difference between the sample with 5% corn meal, and 5% barley flour substitutions. Also, there were no significant differences among, the sample with 20% corn meal, 10% barley flour, and 20% barley flour.

Regarding the crust color score for sponge cake with pectin, data showed that, control had the highest score of crust color, it were 19.70, followed by the sample with 5% corn meal, and 5% barley flour, followed by the sample with 10% corn meal, 10% barley flour, 20% corn meal, and 20% barley flour substitutions, frequently. Also, concord with statistical analyses data revealed that, there were significant differences between control, and the other treatments. Meanwhile, there were no significant differences between the sample with 5% corn meal, and 5% barley flour. Also, there were no significant differences between the sample with 20% corn meal, and 20% barley flour. Also, between 10% corn meal and 10% barley flour.

Concerning the taste score in the same table, data showed that, control treatment had the highest score, it was 19.90, followed by the sample with 5% corn meal, 5% barley flour,

10% corn meal, 10% barley flour, 20% corn meal, and 20% barley flour.

Concerning the data analyzed, it indicated that, there were significant differences between control treatment, and all other treatments. Meanwhile, there was no significant difference between the sample with 5, 10% corn meal, and 5, 10% barley flour substitution, respectively.

Dealing with odor score in the same table, data revealed that, control treatment had the highest score, followed by the sample with 5% corn meal, and 5% barley flour, followed by sample with 10% corn meal, and 10% barley flour and followed by the sample with 20% corn meal, 20% barley flour, respectively.

Also, dealing with statistical analyses, the data revealed that, there were significant differences between the control, and the other treatments. Although there were no significant differences between, the sample with 5% corn meal, and 5% barley flour, 10% corn meal, and 10% barley flour, and 20%corn meal, and 20% barley flour.

Regarding the shape score, it was the highest value of control treatment, then 5% corn meal, 5% barley flour. 10% corn meal, 10% barley flour, 20% corn meal, and 20% barley flour.

The statistical analyses showed that, there were significant differences among control treatment, and other treatments except the treatment with 5% corn meal, meanwhile, there were non-significant differences between 5% corn meal, and 5% barley flour. Also, between 10% corn meal, 5% barley

Table (29) : Organoleptic properties of sponge cake with lecithin

Sponge cakes	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Sponge cakes + lecithin	19.45 a	19.40 a	19.60 a	19.00 a	19.00 a	96.45 a
5% corn meal	19.40 ab	19.35 ab	19.50 ab	19.00 a	19.00 a	96.25 ab
10% corn meal	19.35 ab	19.30 ab	19.45 b	19.00 a	19.00 a	96.10 b
20% corn meal	19.00 c	19.10 c	19.20 c	18.90 a	19.00 a	95.20 d
5% barley flour	19.35 ab	19.30 ab	19.50 ab	19.00 a	18.99 a	96.14 b
10% barley flour	19.30 b	19.25 b	19.40 b	18.90 a	18.90 a	95.75 c
20% barley flour	19.00 c	19.10 c	19.10 c	18.90 a	18.90 a	95.00 d

Means followed by the same letter (s) within each column are not significantly different at 5% level.

flour, 10% corn meal, and 10% barley flour, and 20% corn meal, and 20% barley flour.

Dealing with acceptability score in the same table, noticed that, control treatment had the highest score, meanwhile, the treatment with 20% barley flour substitution had the lowest score.

Statistical analysis showed that there were significant differences among control treatment, and the other treatments.

Meanwhile, there was no significant difference between the treatment with 5, 10 and 20% corn meal, and 5, 10 and 20% barley flour substitution.

4.6.7 Organoleptic properties of sponge cakes with lecithin :

Dealing with data in Table (29), it showed that, for the texture score, control had the highest score, followed by the sample with 5%, 10% corn meal, 5%, 10% barley flour, and 20% corn meal and barley flour, respectively.

Concerning the statistical analysis, data showed that, there were no significant differences among control, 5%, 10% corn meal, and 5% barley flour, frequently. Also, there were no significant differences among 5%, 10% corn meal, 5%, and 10% barley flour substitutions.

On the other hand, there were significant differences among control, 10% barley flour, 20% corn meal, and 20% barley flour. Data revealed that, there were significant differences between control, 10%, 20% barley flour, and 20% corn meal.

Also, dealing with the crust color score, data indicated that, control had the highest score of crust color, followed by the treatments with 5%, 10% corn meal, 5%, 10% barley flour, 20% corn meal and 20% barley flour, frequently.

Concerning the statistic analysis, data showed that, there were significant differences among control, 5%, 10% corn meal, 5%, 10% barley flour, and 20% corn meal, barley flour.

Regarding the taste score, control treatment had the highest score, followed by 5% corn meal, 5% barley flour, 10%, 20% corn meal, and followed by 10%, 20% barley flour, respectively.

Dealing with data of statistical analysis, revealed that, there were significant differences among control, 10%, 20% corn meal, and 10%, 20% barley flour substitutions. Also, there were no significant differences among 5, 10% corn meal, 5% and 10% barley flour.

Concerning the shape score in the same table, data indicated that, control treatment, 5, 10, 20% corn meal substitutions and 5, 10, 20% barley flour had non-significant differences.

Finally, overall acceptability score showed that, there were significant differences among control, and 5% barley flour, 10% corn meal, 10%, 20% barley flour, and 20% corn meal. Meanwhile, there were no significant differences between control, and 5% corn meal, also, among 5% corn meal, 5% barley flour, and 10% corn meal.

Generally, there were highly decreased significantly in 20% corn meal, and barley flour.

Table (30) : Organoleptic properties of sponge cake with CMC 1%

Sponge cakes	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Sponge cakes + CMC	19.30 a	19.35 a	19.40 a	18.99 a	18.99 a	96.03 a
5% corn meal	19.00 b	19.20 b	19.35 ab	18.99 a	18.99a	95.53 b
10% corn meal	18.99 b	19.10 bc	19.25 bc	18.90 a	18.99 a	95.23 bc
20% corn meal	18.90 bc	19.00 c	19.00 c	18.90 a	18.90 ab	94.80 de
5% barley flour	18.99 b	19.15 b	19.25 bc	18.99 a	18.90 ab	95.09 cd
10% barley flour	18.90 bc	19.10 bc	19.20 cd	18.99 a	18.90 ab	95.09 cd
20% barley flour	18.80 c	19.00 c	19.10 de	18.90 a	18.80 b	94.60 e

Means followed by the same letter (s) within each column are not significantly different at 5% level.
CMC = Carboxy methyl cellulose

4.6.8 Organoleptic properties of sponge cakes with carboxy methyl cellulose :

Regarding the data in Table (30), revealed that, control of sponge cake with CMC 1% had the highest score of texture followed by the treatment with 5%, 10%, 20% corn meal substitutions, and 5% barley flour, followed by treatment with 10%, and 20% barley flour. Concerning the data of statistical analysis, there were significant differences among control treatment and all other treatments. Meanwhile, there were no significant differences among the treatment with 5%, 10%, and 20% corn meal, 5%, and 10% barley flour. Also, among 20% corn meal, 10%, and 20% barley flour.

Dealing with crust color score, data showed that, control had the highest score, there were significant differences among control and all other treatments.

Also, there were significant differences among control and all other treatments of taste score.

On the other hand, there were no significant differences among control an all other treatments of odor scores. Whereas, there were significant differences among all treatments and the treatment with 20% barley flour substitution.

Finally, the control treatment had the highest score of over all acceptability, meanwhile, the treatment with 20% barley flour had the lowest score of it.

Table (31) : Organoleptic properties of cracker products

Treatments	Texture	Crust color	Taste	Odor	Shape	Overall acceptability
Control	19.91 a	19.10 a	19.90 a	19.55 a	19.42 a	97.86 a
1	19.90 a	19.00 a	19.90 a	19.60 a	19.40 a	97.80 a
2	18.90 c	18.60 b	19.30 c	19.10 b	19.33 a	95.23 c
3	19.10 b	19.00 a	19.20 c	19.00 b	19.10 b	95.40 c
4	19.87 a	19.00 a	19.90 a	19.50 a	19.30 a	97.57 a
5	19.90 a	19.00 a	19.60 a	19.00 b	19.00 b	96.50 b
6	19.90 a	19.10 a	19.52 b	19.00 b	19.10 b	96.62 b

Means followed by the same letter (s) within each column are not significantly different at 5% level.

(1) Mahlab 1% + yeast 1%

(1) Mahlab 1% + lecithin 1% + malt barley 1.5%

(3)Mahlab 1% + lecithin 1% + malt barley 1.5% + yeast 1%

(4)Malt 1.5% + yeast 1%

(5)Lecithin 1%

(6)Lecithin 1% + yeast 1%

4.6.9 Organoleptic properties of cracker products :

Data in Table (31) show that, there were significant differences among control, treatments No. (1, 4, 5, 6) and treatments No. (2, 3) for texture score. Also, for color score, there were significant differences among control, treatment number (1, 3, 4, 5, 6) and treatments number (2).

On the other hand, there were no significant differences among control, treatment number (1), and No. (4) for taste, and odor score.

Meanwhile, there were significant differences among control, treatments No. (1), (2), (4) and treatments No. (3), (5) and treatment No. (6) for shape score.

Whereas, there were no significant differences among control, treatment No. (1), (4) and treatment No. (2), (3), (5), and treatment number (6).

All these results agree with **Krog (1973)** who reported that emulsifiers are the agent for improvement of texture in many starch foods.

Moreover, are in agreement with **Kamat *et al.*, (1976)** as they suggested that, the tenderness of cakes in the presence of egg yolk are due to establish and bind the effect of the lipoproteins on the fat contained in cake.

Furthermore, are in the same line with those obtained by **Zabik *et al.*, (1977)** as they reported that adding pectin to the bread for improve the staling led to the water absorption which increase by increasing the concentration of pectin.