RESULTS AND DISCUSSION

4. RESULT AND DISCUSSION

4.1. Chemical composition of wheat flour, egg yolk and whey powder:

Table (1) shows the chemical composition of wheat flour (72% extraction rate); yolk powder and whey powder. It could be seen that wheat flour contained 13.24% protein, 1.17% ether extract and 0.55% ash. While yolk powder contained 30.53% protein, 57.40% ether extract and 4.02% ash. Whey powder contained 9.76% protein, 0.8% ether extract and 6.47% ash. Egg yolk powder contained 8.05% Total carbohydrates while whey powder contained 82.97%, (on dry weight basis). The results of wheat flour composition are in agreement with those reported by **Abd El–Magied *et al.* (1991), Hassan *et al.* (1991) and El–Badrawy (1994).**

Burley and Vadehra (1989) reported that the percentages of protein, lipid, carbohydrates and moisture for whole yolk were 17.4, 33.0, 0.2 and 47.5, respectively.

Stadelman and Cotterill (1995) found that the percentage of moisture, protein, total lipid and ash for egg yolk powder were 2.8, 32.9, 60.8 and 3.3, respectively.

Cerbulis *et al.* (1972) mentioned that the composition of the dried whey was lactose 69.2%, protein 10.1%, lipid 4.3% and ash 9.4%.

Table (1): Chemical composition of wheat flour, egg yolk and whey powder.

Types of raw material	Means %				
	Protein*	**Ether extract***	**Ash***	**Total carbohydrates***	**Moisture**
Wheat flour (72 % extraction)	13.24	1.17	0.55	85.04	13.68
Egg yolk powder	30.53	57.4	4.02	8.05	4.0
Whey powder	9.76	0.8	6.47	82.97	4.4

*: values were determined as g/100 g on dry weight sample.

Hugunin (1987) studied the chemical composition of whey powder. He reported that those types had 11–15% protein, 7.1–12.5% ash, 61–75% lactose and 3.5–7.5% water.

Alan and Jane (1994) reported that the percentages of fat, protein, lactose and ash for dry sweet whey were 1.1, 12.9, 74.5 and 8.5, respectively.

4.2. Mineral contents of wheat flour, egg yolk and whey powder:

Mineral contents of wheat flour, egg yolk and whey powders are presented in Table (2). It is observed that egg yolk contained higher contents of calcium, phosphorus, iron and zinc 321.6, 1445.7, 14.15 and 9.12 mg/100 g, respectively. While, whey powder contained higher content of magnesium, sodium and potassium, 200, 800, and 2200 mg/100 g, respectively. **Cotterill *et al.* (1977)** studied the mineral components of egg yolk (solid 50.8%). It contained 136 mg calcium, 5.9 mg iron, 12.4 mg magnesium, 607 mg phosphorus, 110 mg potassium, 61 mg sodium and 3.8 mg zinc per 100 g egg yolk contained 50.8% solids.

Stadelman and Cotterill (1995) found that the mineral components of egg yolk containing 97.2% solids, 267 mg calcium, 10.6 mg iron, 27.6 mg magnesium, 1072 mg phosphorus, 243 mg potassium, 164 mg sodium and 7 mg zinc per 100 g.

Renner and Renz – Schauen (1986) reported the mineral components of sweet whey powder included 800 mg calcium,

Table (2): Mineral contents of wheat flour, egg yolk and whey powder.

Minerals (mg / 100 g)	Wheat flour	Egg yolk	Whey
Magnesium (Mg)	37.30	29.76	200.00
Sodium (Na)	3.22	153.60	800.00
Zinc (Zn)	1.60	9.12	0.20
Manganese (Mn)	0.70	0.20	0.20
Iron (Fe)	1.93	14.15	0.42
Calcium (Ca)	17.70	321.60	87.00
Potassium (K)	118.50	260.00	2200.00
Copper (Cu)	0.25	0.36	0.10
Phosphorus (P)	133.50	1445.70	860.00

- All values were determined as mg / 100 g on dry basis.

700 mg phosphorus, 2000 mg potassium, 800 mg sodium and 80 mg magnesium per 100 g sweet whey powder.

Kulp *et al.* (1988) studied the mineral components of dry whey samples. It contained 210 mg magnesium, 870 mg sodium, 2250 mg potassium, 530 mg calcium and 860 mg phosphorus per 100 g dry whey.

4.3. Rheological properties of wheat flour dough (control) and the doughs fortified with ascorbic acid, egg yolk and whey powder:

4.3.1. Farinogram properties of wheat dough fortified with ascorbic acid, egg yolk and whey powder at different levels:

Farinogram properties of flour doughs were affected by fortification with ascorbic acid, egg yolk and whey powder as shown in Table (3) and Fig. (1a-c). The addition of ascorbic acid to the flour doughs at 2, 8 and 18 mg/100 g flour caused a slight decrease on water absorption and an increase in stability (min). Dough stability was increased from 8.5 min for control sample to 11, 12.5 and 14 min for samples contained 2, 8 and 18 mg ascorbic acid /100 g flour, respectively. The addition of egg yolk at 1 and 3 g/100 g flour levels increased water absorption and stability. The addition also decreased mechanical tolerance index and dough weakening. While the addition of whey powder at 1 and 3 g/100 g flour levels caused a decrease in water absorption, an increase in stability and a decrease in mechanical tolerance index and dough weakening. The addition of 8 mg ascorbic acid, 1 g egg yolk and 1 g whey powder/100 g flour caused a decrease in water absorption, mechanical tolerance index and dough weakening and an increase in mixing time and stability. As the same trend, the addition of 18 mg ascorbic acid, 3 g egg yolk and 3 g whey powder/100 g flour decreased water absorption, mechanical tolerance index and dough weakening and increased mixing time and stability.

Nichlost *et al.* (1980) found that small amounts (2–6 g of L – threo ascorbic acid per 100 kg of flour) caused a pronounced increase of both dough strength and bread volume. During dough mixing L- threo – ascorbic acid is oxidized rapidly to L- threo – dehydro ascorbic acid, the active form of the improver **(Lard *et al.*, 1982)**.

Nakamura and Kurata (1997a) found that the addition of 10 or 100 ppm L – threo – ascorbic acid increased the dough hardness of samples as compared with the control dough.

Gelinas and Lachance (1995) evaluated dough water absorption, peak time and mixing stability on samples, included 1- flour only (control) and 2- flour with sweet whey 6 g (flour basis). They found that the absorption of blends of wheat flour and sweet whey 6 g was decreased and the peak time and stability of the blends were increased compared with control .

Christy *et al.* (1998) found that mixograph water absorption of blends of wheat flour 95% and whey protein 5% was decreased by 4% compared with control. The mixing times of the blends were increase (from 300 sec to 390 sec).

Table (3): Farinogram properties of wheat flour dough (control) and the doughs fortified with ascorbic acid, egg yolk and whey powder at different levels.

Samples	Farinogram properties					
	Water absorption (ml)	Arrival time (min)	Mixing time (min)	Stability period (min)	Mechanical Tolerance index (B.U.)	Dough weakening (B.U.)
Wheat flour (72 % extraction) "control"	59.9	1.5	3.0	8.5	50	80
Flour fortified with 2 mg ascorbic acid/100 g flour.	59.5	1.5	3.0	11.0	30	55
Flour fortified with 8 mg ascorbic acid/100 g flour.	59.4	1.5	3.0	12.5	30	55
Flour fortified with 18 mg ascorbic acid/100 g flour.	59.3	1.5	2.5	14.0	30	50
Flour fortified with 1 g egg yolk/100 g flour	60.1	1.5	3.0	10.0	40	60
Flour fortified with 3 g egg yolk/100 g flour	61.1	1.5	3.0	17.0	15	35
Flour fortified with 1 g whey/100 g flour	58.8	1.5	3.0	11.0	40	60
Flour fortified with 3 g whey/100 g flour	57.1	1.5	4.0	12.5	30	60
Flour fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid / 100 g flour.	58.5	1.5	4.0	14.5	20	40
Flour fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid / 100 g flour.	56.8	1.5	6.0	22.5	20	25

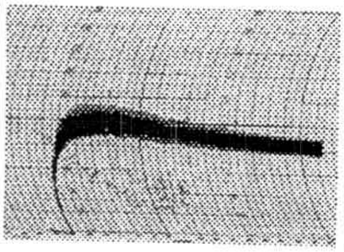
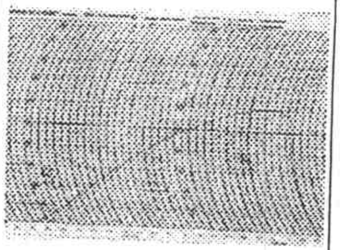
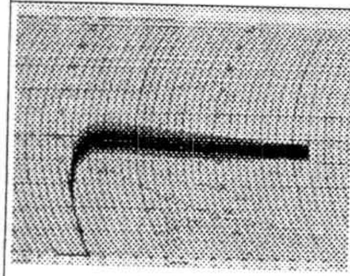
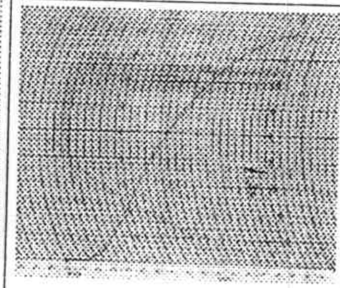
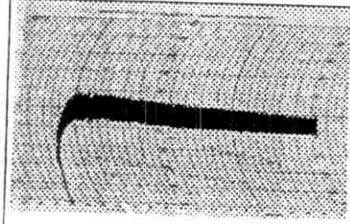
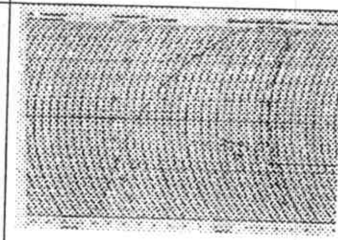
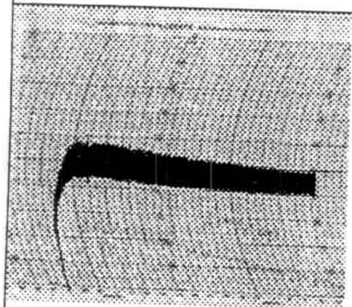
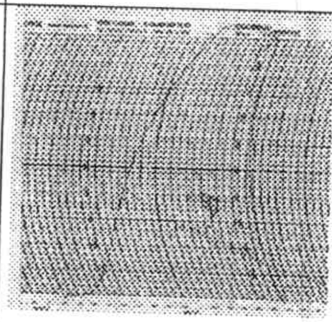
Farinogram	Extensogram	
		**Control (72% wheat flour)**
		**With 2 mg ascorbic acid/100 g flour**
		**With 8 mg ascorbic acid/100 g flour**
		**With 18 mg ascorbic acid/100 g flour**

Fig. (1a): Farinogram and Extensogram of dough

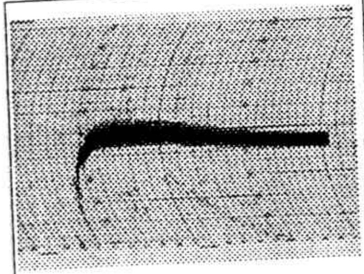
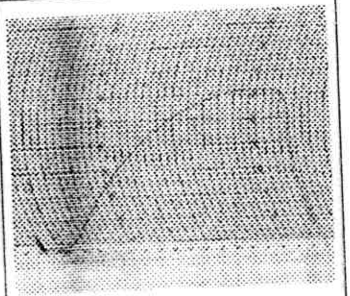
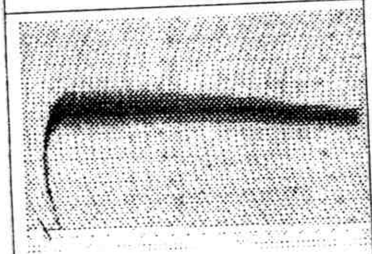
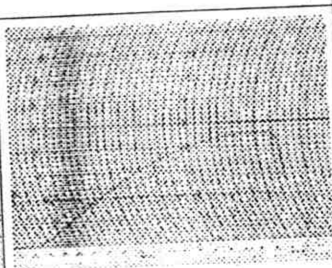
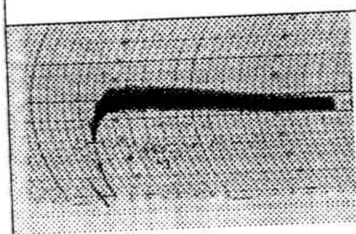
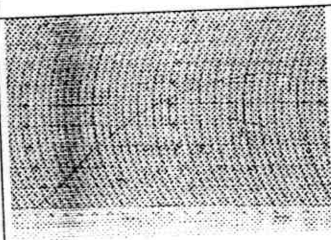
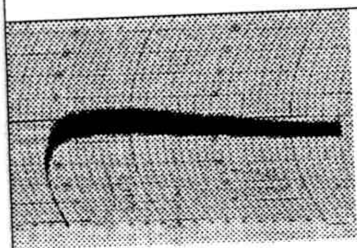
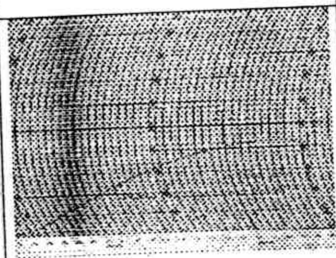
		**With 1 g egg yolk/100 g flour**
		**With 3 g egg yolk/100 g flour**
		**With 1 g whey/100 g flour**
		**With 3 g whey/100 g flour**
Farinogram	**Extensogram**	

Fig. (1b): Farinogram and Extensogram of dough

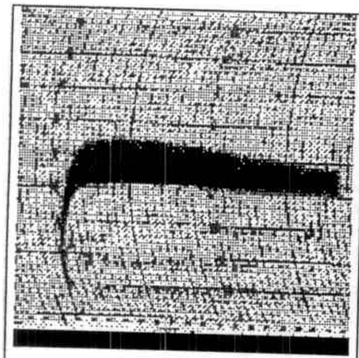
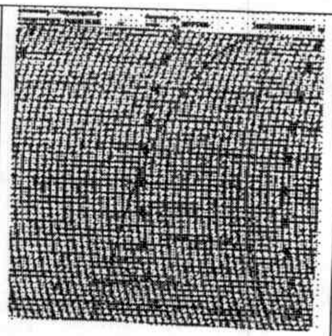
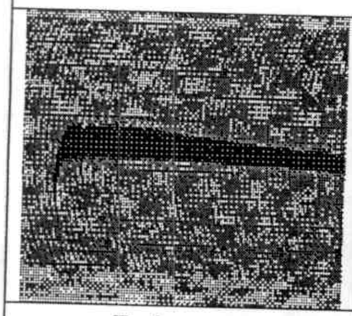
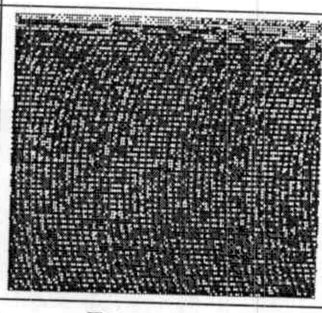
		**With 1 g egg yolk, 1 g whey and 18 mg ascorbic acid/100 g flour**
		**With 1 g egg yolk, 1 g whey and 18 mg ascorbic acid/100 g flour**
Farinogram	**Extensogram**	

Fig. (1c): Farinogram and Extensogram of dough

4.3.2. Extensogram properties of wheat dough fortified with ascorbic acid, egg yolk and whey powder at different levels:

Resistance to extension, extensibility, proportional number and energy of the extensogram properties of dough are shown in Table (4) and Fig. (1a-c). They were affected by fortification with ascorbic acid, egg yolk and whey powder. It could be observed that the addition of 2 mg ascorbic acid to 100 g flour increased the resistance to extension (BU), proportional number and energy. The results increases were 905, 5.48 and 163 BU, respectively, while, in the control sample were 600, 3.16 and 112 BU, respectively. The extensibility of the wheat dough fortified with 2 mg ascorbic was less than in the control 165 and 190, respectively. The dough fortified with 18 mg ascorbic acid had an increase in resistance to extension and proportional number and a decrease in extensibility and energy than that of dough fortified with 2 mg ascorbic acid and than the control except in the property of energy. The energy of dough fortified with 18 mg had 134 for energy, while the control sample had 112. From the table it could be shown that dough fortified with 1 g egg yolk powder had a slight increase in resistance to extension and proportion number than that of control, while had decreased values of extensibility and energy.

On the other hand, raising the addition level of egg yolk to 3 g/100 g flour caused a pronounced decrease in resistance to extension, extensibility, proportional number and energy of the dough. Also dough contained 1 g whey powder had resistance to extension and energy less than control, while it had high

Table (4): Extensogram properties of wheat dough fortified with ascorbic acid, egg yolk and whey powder at different levels:

Samples	Extensogram properties			
	Resistance to extension (R) (B.U.)	Extensibility (E) (mm)	Proportional number (P.N.)	Energy (cm^2)
Wheat flour (72% extraction) "control"	600	190	3.1 6	112
Flour fortified with 2 mg ascorbic acid/100 g flour.	905	165	5.48	163
Flour fortified with 8 mg ascorbic acid/100 g flour.	>1000	146	6.85	153
Flour fortified with 18 mg ascorbic acid/100 g flour.	>1000	132	7.58	134
Flour fortified with 1 g egg yolk/100 g flour	625	165	3.90	103
Flour fortified with 3 g egg yolk/100 g flour	455	184	2.47	90
Flour fortified with 1 g whey/100 g flour	640	200	3.20	154
Flour fortified with 3 g whey/100 g flour	430	215	2.00	96
Flour fortified with 1 g egg yolk, 1 gwhey and 8 mg ascorbic acid/100 g flour.	980	130	7.54	132
Flour fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour.	>1000	132	7.58	145

extensibility and proportion number. The dough contained 3 g whey powder had lower values of resistance to extension, proportional number and energy than that of control, while it had higher value of extensibility than that of control sample.

From the table, the dough fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid/100 g flour and the dough fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid had higher values of resistance to extension, proportion number and energy and had lower values of extensibility and energy than that of control sample.

Rolf Kieffer *et al.* **(1990)** stated that L-threo – ascorbic acid affect on the dough rheological properties in the extensograph. When addition L – threo – ascorbic acid to flour, the resistance to mixing (R) increased from 56 to 82 mm, the extensibility (E) was reduced from 99 to 59 mm, the extensibility number (R/E) increased from 0.57 to 1.39 **(Grosch and Wieser, 1999)**.

Kulp *et al.* **(1988)** found that extensograph values indicated an increase in extensibility (E) and decrease in resistance to extension (R) of doughs with higher levels of whey.

Srivastava *et al.* **(1996)** studied the use of whey solids with wheat flour. Dried whey was added to flour at 3 – 15%; dough was analyzed for extensogram properties. Inclusion of whey solids at 3 and 10 g lowered the resistance to extension from 775 BU (control) to 715 and 680 BU, respectively.

The results indicated that the falling number was 437 sec. for wheat flour (72% extraction).

4.4. Chemical composition of pan bread (control) and pan bread fortified with ascorbic acid, egg yolk and whey powder:

Chemical composition of pan bread (control) and pan bread fortified with egg yolk, whey powder and ascorbic acid are presented in Table (5). Moisture content of all the samples of pan bread had almost the same value. It was ranged between 37.04 to 37.62%. The protein and ether extract contents of pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid were higher than that of the control and the other fortified bread samples. The same two samples had lower content of carbohydrates than the other samples.

4.5. Mineral contents of pan bread (control) and pan bread fortified with egg yolk, whey and ascorbic acid:

The mineral contents of pan bread (control), pan bread fortified with 1 g/100 g flour from each of egg yolk and whey and 8 mg ascorbic acid/100g flour and pan bread fortified with 3 g from each of egg yolk and whey and 18 mg ascorbic acid/100 g flour, are shown in Table (6). It could be seen that bread fortified with 3 g egg yolk + 3 g whey + 18 mg ascorbic acid had higher contents of sodium, calcium, potassium, magnesium and phosphorus than that contained 1 g egg yolk + 1 g whey and 8 mg ascorbic acid and than that without additives (control).

Table (5): Chemical composition of pan bread (control) and pan bread fortified with ascorbic acid, egg yolk and whey powder:

Samples	Means %				
	***Total crude Protein**	***Ether extract**	***Ash content**	***Total carbohydrates**	**Moisture content**
Pan bread (control)	11.66	5.30	1.34	81.70	37.62
Pan bread fortified with 8 mg ascorbic acid/100 g flour.	11.66	5.30	1.34	81.70	37.23
Pan bread fortified with 18 mg ascorbic acid/100 g flour.	11.66	5.30	1.33	81.71	37.34
Pan bread fortified with 3 g egg yolk/100 g flour	12.11	6.70	1.45	79.74	37.40
Pan bread fortified with 3 g whey/100 g flour	11.59	5.30	1.52	81.59	37.04
Pan bread fortified with I g egg yolk, 1 g whey and 8 mg ascorbic acid/100 g flour.	11.79	5.74	1.43	81.04	37.17
Pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour.	12.02	6.57	1.62	79.79	37.28

*: values were determined as g / 100 g on dry weight basis.

Table (6): Mineral contents of pan bread (control) and the flour fortified with egg yolk, whey and ascorbic acid:

Minerals (mg / 100 g)		Pan bread (control)	Fortified pan bread	
			1	2
Magnesium	(Mg)	32.55	34.90	39.47
Sodium	(Na)	521.70	531.15	551.05
Zinc	(Zn)	1.37	1.38	1.65
Manganese	(Mn)	0.60	0.64	0.67
Iron	(Fe)	1.70	1.76	1.98
Calcium	(Ca)	15.40	19.50	27.70
Potassium	(K)	103.21	127.80	178.20
Copper	(Cu)	0.22	0.22	0.22
Phosphorus	(P)	116.7	139.82	191.15

Where: - All values were determined as mg/100 g on dry basis.

1 = Pan bread fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid/100 g flour.

2 = Pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour.

4.6. Stability of vitamin C in dough before and after fermentation and in the produced pan bread fortified with egg yolk, whey and ascorbic acid during the storage periods:

Vitamin C content in the dough before and after fermentation and in the produced pan bread fortified with egg yolk, whey and ascorbic acid during the storage periods is presented in Table (7). The percentage of the retained of vitamin C was less in dough after fermentation than that before fermentation by about 3%. After bread making the retained of vitamin C was decreased to 73% in case of bread fortified with 8 mg ascorbic acid, while it was decreased to 76. 16% in case of bread fortified with 18 mg ascorbic acid. The period of pan bread storage also affected the stability of vitamin C. The decrease in the retained was reached 17.5%, in case of bread fortified with 8 mg ascorbic acid after 3 days of storage, while it was reached 23.33% in case of bread fortified with 18 mg ascorbic acid after 3 days of storage (Fig., B1-3).

L-ascorbic acid is often added at low level (< 100 ppm) to bread dough to modify its rheological properties. But at this level practically no L–ascorbic acid remains in freshly baked bread **(Thewlis, 1971)**.

Elkassabany and Hoseney (1980) and Seib (1985) stated that immediately before baking, the total L–ascorbic acid retained in proofed doughs was 97–100% of that added at the mixer. The high survival of L–ascorbic acid in dough was due to the presence of yeast. Yeast almost instantly consumes the oxygen

Table (7): Stability of vitamin C in dough before and after fermentation and the produced pan bread fortified with egg yolk, whey and ascorbic acid during the storage periods:

Fortified samples							
Sample	1			Sample	2		
	Age (days)	ASA in sample	ASA retained %		Age (days)	ASA in sample	ASA retained %
Befor fermentation	-	7.94	99.25	Befor fermentation	-	17.90	99.44
After fermentation	-	7.64	95.50	After fermentation	-	17.40	96.67
Bread	0	5.84	73.00	Bread	0	13.71	76.16
Bread	1	4.16	52.00	Bread	1	10.26	57.00
Bread	2	2.33	29.12	Bread	2	6.30	35.00
Bread	3	1.40	17.50	Bread	3	4.20	23.33

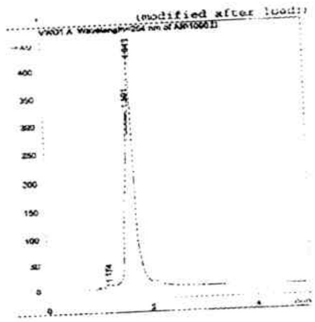
Where: - Values were determined as mg / 100 g sample.

- ASA: L – threo – ascorbic acid.

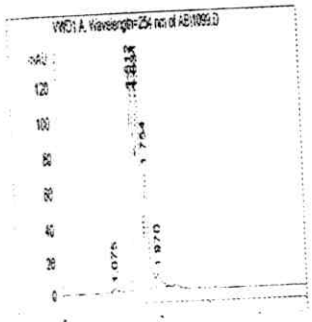
1 = samples fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid / 100 g flour.

2 = samples fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid / 100 g flour.

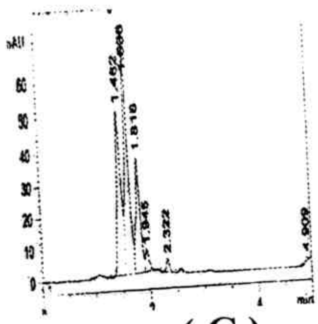
(Standard)



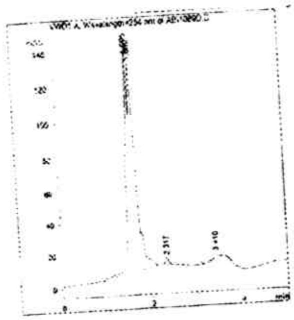
(A)



(B)



(C)



(D)

Fig (B1): HPLC chromatograms of vitamin C in dough fortified with

A- 8 mg ascorbic acid/100 g flour before fermentation.

B- 8 mg ascorbic acid/100 g flour after fermentation.

C- 18 mg ascorbic acid/100 g flour before fermentation.

D- 18 mg ascorbic acid/100 g flour after fermentation.

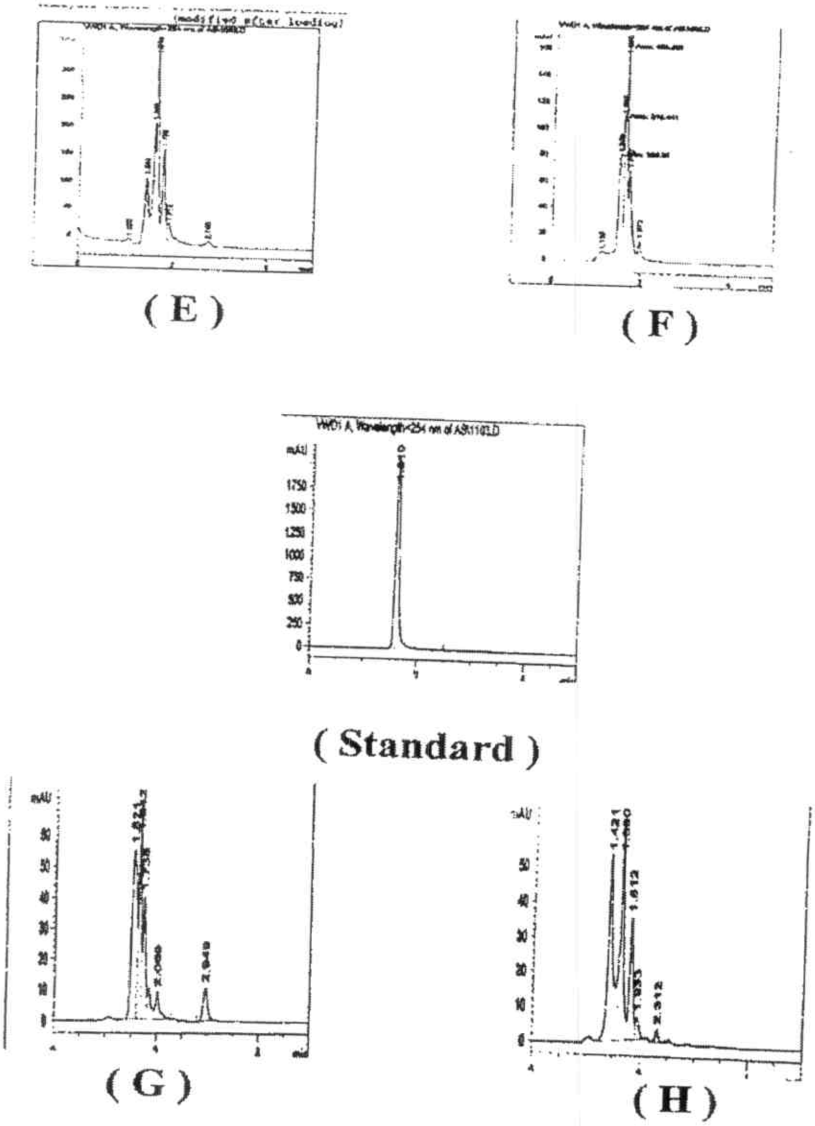


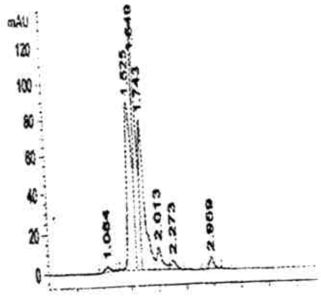
Fig. (B2): HPLC chromatograms of vitamin C in pan bread fortified with

E- 8 mg ascorbic acid/100 g flour after baking.

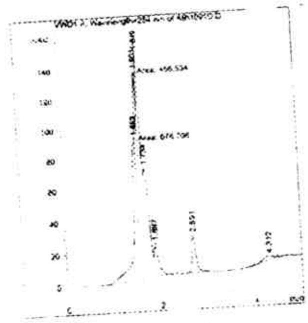
F- 18 mg ascorbic acid/100 g flour after baking.

G- 8 mg ascorbic acid/100 g flour and stored for 1 day.

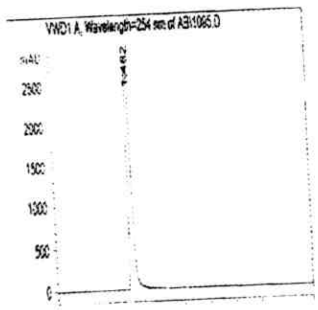
H- 18 mg ascorbic acid/100 g flour and stored for 1 day.



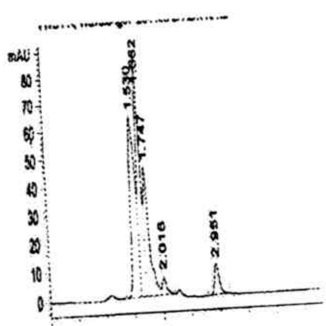
(I)



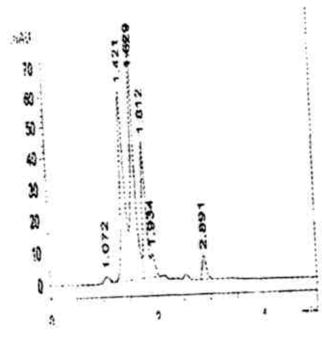
(J)



(Standard)



(L)



(M)

Fig. (B3): HPLC chromatograms of vitamin C in pan bread fortified with

I- 8 mg ascorbic acid/100 g flour and stored for 2 days.
J- 18 mg ascorbic acid/100 g flour and stored for 2 days
L- 8 mg ascorbic acid/100 g flour and stored for 3 day.
M- 18 mg ascorbic acid/100 g flour and stored for 3 day.

in dough during mixing which gives anaerobic environment during fermentation and proofing of dough. The net result is protection of L–ascorbic acid (ASA) retention in proofed dough immediately before baking was 99%. During the baking step, about 23% of ASA was destroyed and much more disappeared during seven days of bread storage at room temperature. After 1, 3 and 5 days of storage, one serving (one slice, 28g) of the bread would provide13, 7 and 4% of the adult U.S. recommended daily allowance (RDA) of ASA, respectively. However, pound loaves of bread (300 g of flour) with their lower specific surface area would retain more ASA than pup loaves (100 g of flour) **(Park *et al.*, 1994 and 1997)**.

4.7. Protein and protein digestability of wheat flour, egg yolk, whey powder and pan bread fortified with these materials:

The Protein contents and protein digestability of wheat flour, egg yolk, whey and pan bread fortified with 1 and 3 g levels of egg yolk, and whey are presented in Tables (8 and 9). It is clear that protein digestability of egg yolk and whey ranged from 96.6 to 96.9, respectively. From the tables, it is clear that protein digestability was increased in pan bread fortified with 3 g levels of egg yolk and whey (86.2%) than that fortified with 1 g levels of egg yolk and whey (80.3%).

Incorporation of dairy protein into wheat – based products not only increases their protein content, but also improves their nutritional value by increasing the content of essential amino

Table (8): Protein and protein digestability of wheat flour, egg yolk powder and whey powder.

Rraw materials	Protein content	Protein digestability (g / 100 g protein)
Wheat flour	13.24	76.3
Egg yolk powder	30.53	96.6
Whey powder	9.76	96.9

Table (9): Protein and protein digestability of pan bread (control) and the pan bread fortified with egg yolk whey and ascorbic acid.

Samples	Protein content	Protein digestability (g / 100 g protein)
Pan bread (control)	11.66	77.60
Pan bread fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid/100 g flour	11.79	80.30
Pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour	12.02	86.20

Where: - Values were determined as g / 100 g on dry basis.

acids such as Lycin, Methionine, Iso- Leucine and Tryptophan **(Warren *et al.*, 1983)**.

FAO and WHO (1991) reported that the protein digestability of egg is 97%, milk is 95%, wheat cereal is 77% and wheat flour white is 96%.

4.8. Physical properties of fortified pan bread:

The effect of pan bread fortification with ascorbic acid, egg yolk and whey powder on weight (g), volume (cm^3) specific volume (cm^3/g) and the percentage increased of specific volume are presented in Table (10). It was observed that the loaf weight (g) was slightly increased from 156.44 g for control to 156.72 g for pan bread fortified with 8 mg ascorbic acid/100 g flour while it was decreased in the case of bread fortified with 18 mg ascorbic acid to 156.2 g. On contrast the loaf volume and specific volume of bread fortified with 18 mg ascorbic acid had a higher value than that fortified with 8 mg ascorbic acid and the control bread. The percentage increase of specific volume of loaf contained 18 mg ascorbic acid was 25.67, while it was 15.24 in the case of loaf contained 8 mg/100 g flour. Also the specific volume (cm^3/g) of loaf fortified with whey or egg yolk powders 3 g level had higher values than that of the control bread and lower values than that of the bread fortified with ascorbic acid and the control bread. The percentage increase of specific volume of pan bread contained 3 g egg yolk was higher than that of the bread contained 3 g whey powder. From the table, it is shown that pan bread fortified with 3 g egg yolk, 3 g whey and

Table (10): Effect of fortified wheat flour with ascorbic acid, egg yolk and whey powder on the physical properties of pan bread.

Samples	Physical properties of pan bread			
	Weight (g)	Volume (cm^3)	Specific volume (cm^3 / g)	The percentage increase of specific volume
Pan bread (control)	156.44	585	3.74	-
Pan bread fortified with 8 mg ascorbic acid / 100 g flour.	156.72	675	4.31	15.24
Pan bread fortified with 18 mg ascorbic acid / 100 g flour.	156.20	735	4.70	25.67
Pan bread fortified with 3 g egg yolk/100 g flour	**154.55**	660	**4.27**	**14.17**
Pan bread fortified with 3 g whey/100 g flour	156.31	640	4.09	9.36
Pan bread fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid / 100 g flour.	155.55	740	4.76	27.27
Pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid / 100 g flour.	154.50	805	5.21	39.30

18 mg ascorbic acid had higher values in volume, specific volume and the percentage increase of specific volume than that fortified with 1 g egg yolk, 1 g whey powder and 8 mg ascorbic acid.

Rolf Kieffer *et al.* **(1990)** found that small amounts of L-threo – ascorbic acid caused a pronounced increase in dough strength. During dough mixing, L–threo–ascorbic acid was oxidized rapidly to L-threo –dehydro ascorbic acid, the active form of the improver.

The improver effect of L-threo– ascorbic acid on the rheological properties of dough was found that L–threo–ascorbic acid, in the range of 20–30 mg/kg flour, caused a pronounced increase in dough strength with the consequence that the bread volume was up to 20% higher than that of the control **(Grosch and Wieser, 1999).**

Birch and Finney (1980) reported that using fresh egg yolk resulted in an increase in loaf volume. Increasing the level of fresh egg yolk to 11% resulted in pan bread with a higher volume (from 732 to 1118 cc).

Mizyakin (1983) found that, milk whey containing 8.5% protein, 60–65% lactose, had low hygroscopicity and was added at 3% to bakery products; it increased volume by 10–15% and improved crumb elasticity. **Kulp** *et al.* **(1988)** observed increase in specific volume of pan bread with increase whey protein content.

4.9. Effect of fortification on the storage period of pan bread:

Table (11) shows the rate of decrease of moisture contents during the storage periods (24, 48, 72 and 96 hrs) of pan bread (control) and the bread fortified with egg yolk, whey and ascorbic acid. After 24 hrs of baking; the percentage decrease of moisture content of pan bread (control) was 11.62%, while it decreased to 9.5% in case of bread fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid. The percentage decrease moisture was lower in case of bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid than that of control and the other fortified bread. After 48, 72 and 96 hrs, the rate of decrease of moisture content of pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid was lower than that of pan bread contained 1 g egg yolk, 1 g whey and 8 mg ascorbic acid and control bread.

Table (12) shows the staling rate of pan bread fortified with two different levels of egg yolk, whey and ascorbic acid measured by penetrometer. It is observed that pan bread fortified with egg yolk, whey and ascorbic acid was staled slower than that of control. Pan bread fortified with 3 g level of egg yolk and whey was staled slower than that fortified with 1 g level of egg yolk and whey.

The results are in agreement with **Brich and Finney (1980) and Arnoczky *et al.* (1996).**

Table (11): Rate of decrease of moisture contents during the storage periods of pan bread (control) and the pan bread fortified with egg yolk, whey and ascorbic acid.

Sample	Storage period (hour)								
	Zero time	24 hr	moisture decrease %	48 hr	moisture decrease %	72 hr	moisture decrease %	96 hr	moisture decrease %
Pan bread (control)	37.62	33.25	11.62	30.49	8.30	28.75	5.71	27.57	4.10
Pan bread fortified with l g egg yolk, 1 g whey and 8 mg ascorbic acid/100 g flour.	37.17	33.64	9.50	31.32	6.90	29.69	5.20	28.50	4.01
Pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour.	37.28	35.86	3.81	34.75	3.09	33.80	2..73	33.00	2.37

Table (12): Staling rate for pan bread fortified with egg yolk, whey and ascorbic acid after baking and after 1, 2, 3, and 4 days determining by Pentrometer as penetrometer unit (PU) in gm cm $^{-2}$.

Samples	Moisture %	Measurements of pan bread after									
		Baking		1 day		2 days		3 days		4 days	
		PU	The percent-age decrease	PU	The percent-age decrease	PU	The percent-age decrease	PU	The percent-age decrease	PU	The percent-age decrease
Control	37.62	243.66 c	100	180.66 c	74.1	145.66 c	59.8	101.33 c	41.6	nd	nd
A	37.17	292.33 b	100	259.66 b	88.8	234.33 b	80.1	210.0 b	71.8	169 b	57.8
B	37.28	356.33 a	100	336.33 a	94.4	321.33 a	90.2	297.66 a	83.5	268.3 a	75.3
L.S.D. (0.05)		13.05		16.47		9.15		6.98		12.90	

A= pan bread fortified with 1 g egg yolk, 1g whey and 8 mg ascorbic acid / 100 g flour; B = pan bread fortified with 3 g egg yolk, 3g whey and 18 mg ascorbic acid / 100 g flour

nd: no determined.

4.10. Organoleptic properties of pan bread (control) and pan bread fortified with egg yolk, whey and ascorbic acid.

Sensory characteristics of pan bread containing different levels of ascorbic acid, egg yolk and/or whey powder are presented in Table (13). The measured sensory characteristics included external characteristics (crust color, symmetry, evennes of bake, character of crust and break and shard), internal characteristics (grain, taste, crumb color, texture, aroma, keeping quality) and overall score. The results indicated that the addition of 18 mg ascorbic acid + 3 g egg yolk + 3 g whey caused a significant increase in external, internal characteristics and overall score of the produced pan bread than that of the control and the other fortified. The data in the table generally showed that the combination between the three materials of ascorbic acid, egg yolk and whey increased the acceptability of pan bread with increasing of the addition level.

Egg yolk had an emulsifying action and improver structural characteristics and may influence the flavor and color of fine bakery products **(Ludewig, 1982).**

The sensory characteristics, specific volume and expansion of bakery products made with whey were evaluated and were not significantly different from those of products made with milk. In addition, it was found that the whey products were superior in flavor to those made with milk. **(Vitti and Etore – do – Valle, 1987).**

Srivastava *et al.* (1996) studied the effect of adding whey solids at the level of 3 g to the bakery products. They found that

Table (13): Organoleptic properties of pan bread (control) and pan brad fortified with egg yolk, whey and ascorbic acid.

Quality	Maximum score	Pan bread No.*							L.S.D
		1	2	3	4	5	6	7	(0.05)
External properties (20)									
Crust color	8	6.00 d	6.00 d	6.30 cd	7.00 b	6.56 c	7.00 b	7.98 a	0.30
Symmetry	3	1.96 d	2.20 c	2.36 bc	2.48 bc	2.42 bc	2.62 b	2.96 a	0.20
Evennes of bake	3	2.30 c	2.28 c	2.32 c	2.48 bc	2.5 bc	2.58 b	2.88 a	0.19
Character of crust	3	2.00 d	2.10 cd	2.10 cd	2.58 b	2.28 c	2.60 b	3.00 a	0.01
Break and Shared	3	2.00 e	2.12 de	2.10 de	2.52 c	2.26 d	2.70 b	3.00 a	0.01
Internal properties (80)									
Grain	15	10.90 c	10.90 c	11.42 c	12.98 b	12.96 b	13.02 b	14.56 a	0.65
Taste	15	11.24 c	11.24 c	11.30 c	13.04 b	13.48 b	13.02 b	14.54 a	0.53
Crumb color	15	9.12 e	10.35 d	11.18 c	12.69 b	10.50 d	12.72 b	15.00 a	0.51
Texture	15	10.68 d	11.19 d	12.30 c	11.97 c	11.09 d	13.20 b	15.00 a	0.61
Aroma	10	7.20 c	7.20 c	7.26 c	8.48 b	8.56 b	8.48 b	9.96 a	0.31
Keeping quality	10	8.00 d	8.02 d	8.10 d	8.44 c	9.02 b	9.02 b	9.96 a	0.29
Over all score	100	71.40 e	73.60 de	76.68 cde	84.66 bc	81.63 bcd	86.96 b	98.84 a	8.76

*: (1) = pan bread (control).; (2) = pan bread fortified with 8 mg ascorbic acid/100 g flour.; (3) = pan bread fortified with 18 mg ascorbic acid/100 g flour; (4) = pan bread fortified with 3 g egg yolk/ 100 g flour.; (5) = pan bread fortified with 3 g whey/100 g flour.; (6) = pan bread fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid/ 100 g flour.; (7) = pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour

a, b, c, d: There is no significant difference (P>0.05) between means within the same quality attribute.

color, texture and taste of products were improved. However, increasing the level of whey solids to 10% improved nutritional value.

4.11. Organoleptic properties of pan bread (control) and pan bread fortified with egg yolk, whey and ascorbic acid after baking and after 1, 2 and 3 days:

Sensory characteristics of pan bread (control), pan bread containing 8 mg ascorbic acid + 1 g egg yolk + 1 g whey and pan bread containing 18 mg ascorbic + 3 g egg yolk + 3 g whey during storage periods (after 1 hr of baking, after 24 hr and 72 hrs are presented in Table (14). The results indicated that generally, there were significant differences between pan bread fortified with ascorbic acid + egg yolk + whey during storage periods and pan bread (control). However, pan bread fortified with 18 mg ascorbic acid + 3 g egg yolk + 3 g whey had a significant effects on the external, internal and overall score acceptability than that fortified with lower contents (8 mg ascorbic acid + 1 g egg yolk + 1 g whey). It could be concluded that the increase of the combination of ascorbic acid + egg yolk + whey caused a decrease in the staling rate of pan bread fortified with these materials.

Kamat *et al.* (1976) stated that the tenderness of bakery products in the presence of egg yolk was due to the stability and binding effect of the lipoproteins on the fat which ensured their even distribution in bakery during baking.

Table (14): Organoleptic properties of pan bread (control) and pan bread fortified with egg yolk, whey and ascorbic acid after baking and after 1, 2 and 3 days.

Quality	Maximum score	Pan bread after baking No.*				Pan bread after 1 day No.*				Pan bread after 2 day No.*				Pan bread after 3 day No.*			
		1	2	3	L.S.D (0.05)	1	2	3	L.S.D (0.05)	1	2	3	L.S.D (0.05)	1	2	3	L.S.D. (0.05)
External properties (20)																	
Crust color	8	6.00 c	7.00 b	7.89 a	0.30	5.80 c	6.89 b	7.96 a	0.19	5.72 c	6.82 b	7.98 a	0.18	5.62 c	6.79 b	7.92 a	0.39
Symmetry	3	1.96 c	2.62 b	2.96 a	0.20	2.00 c	2.62 b	2.98 a	0.19	198 c	2.58 b	2.98 a	0.19	2.00 c	2.60 b	2.96 a	0.27
Evennes of bake	3	2.30 c	2.58 b	2.88 c	0.19	2.30 c	2.60 b	2.94 a	0.16	2.28 c	2.60 b	2.92 a	0.18	2.28 c	2.48 b	2.88 a	0.13
Character of crust	3	2.00 c	2.60 b	3.00 a	0.01	1.80 c	2.52 b	2.96 a	0.12	1.56 c	2.22 b	3.00 a	0.19	1.30 c	2.02 b	2.84 a	0.24
Break and Shared	3	2.00 c	2.70 b	3.00 a	0.01	1.76 c	2.52 b	3.00 a	0.15	1.52 c	2.30 b	2.96 a	0.19	1.40 c	2.12 b	2.94 a	0.23
Internal properties (80)																	
Grain	15	10.90 c	13.02 b	14.56 a	0.65	9.70 c	12.94 b	14.44 a	0.55	8.10 c	12.30 b	14.18 a	0.33	7.50 c	11.08 b	13.80 a	0.43
Taste	15	11.24 c	13.02 b	14.54 a	0.53	10.60 c	12.68 b	14.54 a	0.44	9.50 c	12.10 b	14.28 a	0.52	8.00 c	11.36 b	13.86 a	0.49
Crumb color	15	9.12 c	12.72 b	14.94 a	0.51	9.06 c	12.75 b	15.00 a	0.32	8.70 c	12.30 b	14.94 a	0.32	7.50 c	11.73 b	14.91 a	0.37
Texture	15	10.68 c	13.20 b	15.00 a	0.61	9.18 c	12.24 b	15.00 a	0.27	8.97 c	11.7 b	14.50 a	0.35	7.00 c	10.80 b	14.28 a	0.48
Aroma	10	7.20 c	8.48 b	9.96 a	0.31	7.06 c	8.52 b	9.96 a	0.19	6.54 c	8.22 b	9.60 a	0.34	5.20 c	7.78 b	9.54 a	0.31
Keeping quality	10	8.00 c	9.02 b	9.96 a	0.29	7.60 c	9.00 b	10.00 a	0.32	7.48 c	8.50 b	9.72 a	0.34	6.10 c	7.96 b	9.52 a	0.38
Overall score	100	71.40 c	86.96 b	98.84 a	1.99	66.86 c	85.37 b	98.78 a	3.99	62.35 c	81.64 b	97.06 a	2.72	53.90 c	76.72 b	95.45 a	0.99

(1) = pan bread (control).. (2) = pan bread fortified with 1 g egg yolk, 1 g whey and 8 mg ascorbic acid/100 g flour.:
(3) = pan bread fortified with 3 g egg yolk, 3 g whey and 18 mg ascorbic acid/100 g flour
a, b, c: There is no significant difference (P>0.05) between means attribute within the same storage period.

Bakery products containing whey had extended shelf life and improved crumb properties, with product sensory and physico chemical properties also being very good.**(Cubakowski *et al.*, 1983).**

The tenderness of bread made with whey powder could be due to its high lactose content since the texture of bread was related to its sugar and moisture content **(Brown, 1984).**