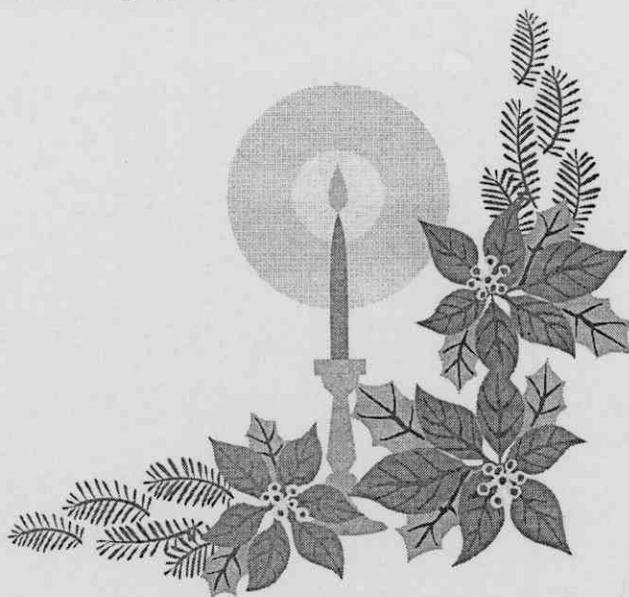
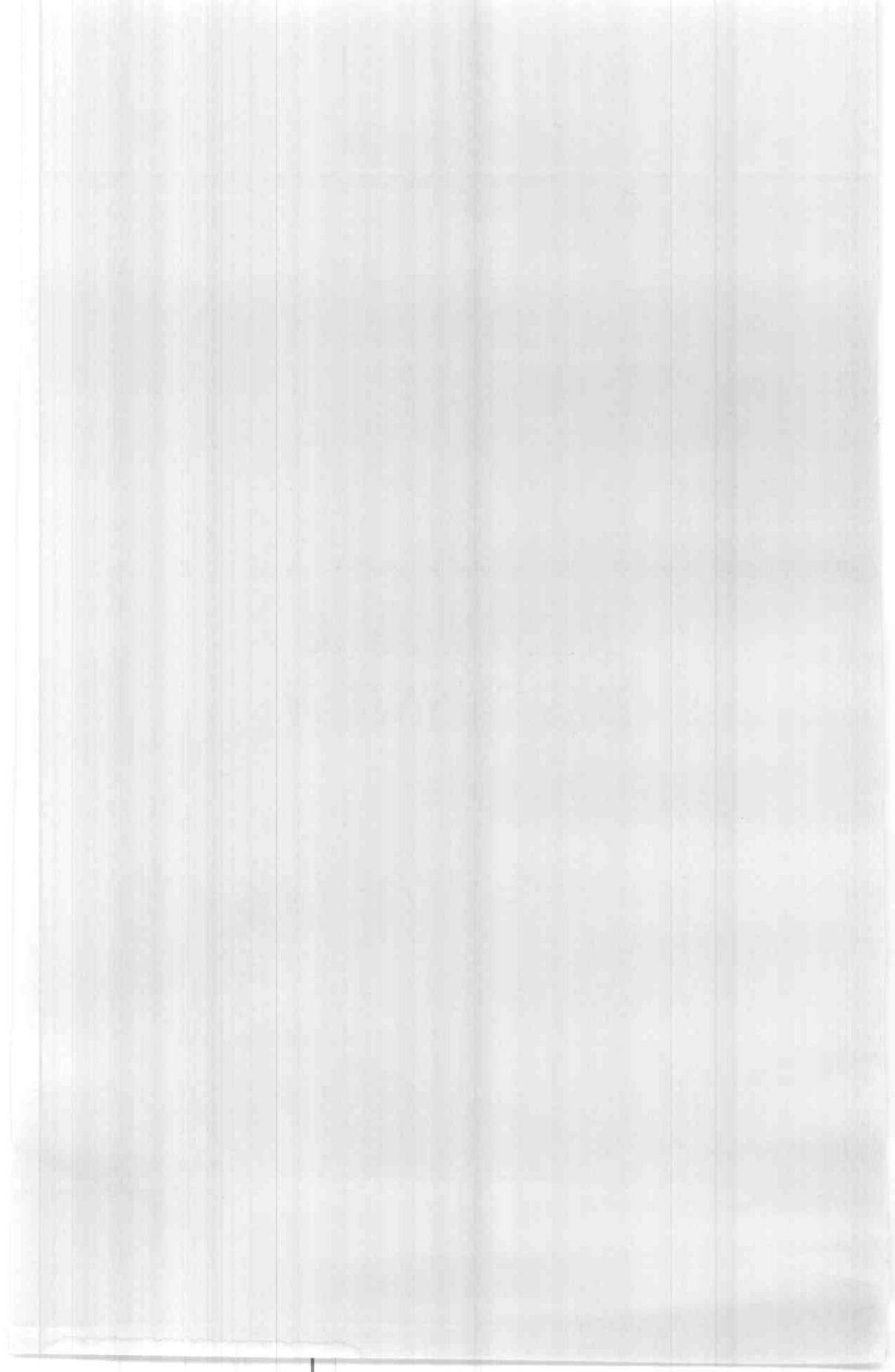




***RESULTS &  
DISCUSSION***





## 4. RESULTS AND DISCUSSION

### 4.1. Chemical composition of raw materials:

Wheat flour (82% extraction rate), corn flour (97% extraction rate), blend of 80% wheat flour plus 20% corn flour, defatted soybean flour, whey powder and skim milk powder were analyzed for their chemical composition.

Data in Table (1) indicated that, the addition of corn flour to wheat flour increased ether extract and ash content from 2.61 and 1.36% for wheat flour to 3.36, and 1.41% (on dry weight basis) for the mixture of 80% wheat flour + 20% corn flour, respectively. While, it was 13.89, 14.12 and 81.91% for moisture, crude protein and total available carbohydrates of wheat flour compared with 13.60, 13.68 and 81.55% for the mixture of 80% wheat flour and 20% corn flour, respectively.

Also, in the same table, the defatted soybean had the highest contents of protein (51.46%). Whey powder and skim milk contained 13.71 and 36.98% of protein, respectively (on dry weight basis).

Defatted soybean flour, whey and skim milk powders contained ash 6.74, 8.41 and 7.89%, respectively (on dry weight basis).

These results are in agreement with finding of Ramadan (1986), Mohsen *et al.* (1997), Seleem (2000), Farag (2003) and Mohy El-Din (2004).

**Table (1): Chemical composition of raw materials (mean±SD).**

Raw materials	Moisture (%)	Total protein* (%)	Ether extract* (%)	Ash* (%)	Total carbohydrates* <sup>@</sup> (%)
Wheat flour (82% ext.) (WF)	13.89±0.03	14.12±0.02	2.61±0.01	1.36±0.01	81.91±0.03
Corn flour (97% ext.) (CF)	12.41±0.06	11.99±0.02	6.31±0.02	1.58±0.01	80.12±0.02
Blend 80% WF + 20% CF	13.60±0.04	13.68±0.05	3.36±0.02	1.41±0.02	81.55±0.03
Defatted soybean flour (DSF)	6.68±0.04	51.46±0.03	4.02±0.03	6.74±0.02	37.78±0.04
Whey powder (WP)	4.49±0.05	13.71±0.03	1.16±0.01	8.41±0.03	76.72±0.02
Skim milk powder (SMP)	4.10±0.03	36.98±0.02	1.08±0.01	7.89±0.03	54.05±0.03

\* On dry weight basis.

<sup>@</sup>: Carbohydrate calculated by difference.

## **4.2. Minerals content in raw materials:**

Data in Table (2) show the minerals content of raw materials. Whey powder contained the highest value of potassium (2210.00 mg/100 g) and sodium (811.00 mg/100 g) (on wet weight basis), while, had lower content from iron.

Also, data in the same table, showed that, the defatted soybean flour contained higher contents of manganese, iron, copper and zinc. Skim milk powder contained the highest contents of magnesium, calcium and phosphorus. Wheat flour had lower contents of these minerals compared with defatted soybean and skim milk.

Also, 80% wheat flour + 20% corn flour had higher content of all minerals except manganese (0.09 mg/100 g) and copper (0.21 mg/100 g) compared with wheat flour without additives.

These results are in agreement with Abd El-Moutaleb (2001).

## **4.3. Rheological measurements of dough formula:**

The rheological properties of dough have an immediate impact on functionality of dough, therefore, it may be used as reliable predictors of its behavior during the baking process as well as the quality of the final product.

### **4.3.1. Farinograph parameters:**

The farinograph is the most universally used for physical dough-testing instrument to measure the plasticity and mobility

Table (2): Minerals content of raw materials (mg/100 g on wet weight basis).

Raw materials	K	Mg	Ca	Na	P	Mn	Fe	Cu	Zn
Wheat flour (82% ext.) (WF)	121.51	117.22	17.78	23.27	144.18	0.09	1.20	0.22	0.08
Corn flour (97% ext.) (CF)	205.26	174.43	18.46	38.26	280.13	0.08	3.90	0.83	3.08
Blend 80% WF + 20% CF	136.21	128.10	18.10	26.31	169.11	0.09	1.43	0.21	0.10
Defatted soybean flour (DSF)	136.89	214.46	179.56	37.26	203.66	3.86	19.34	3.71	8.33
Whey powder (WP)	2210.00	212.00	87.00	811.00	862.00	0.21	0.45	0.12	0.23
Skim milk powder (SMP)	1550.00	252.00	1290.00	557.00	1020.00	0.32	0.62	0.21	0.17

of the dough. It records the resistance dough offers to the mixing blends during a prolonged and relatively gentle mixing action at a constant temperature (Shuey, 1975).

Data in Table (3) and illustrated Fig. (1) showed that, the water absorption of wheat flour [control 1 (C1)] was 56.2%, while it was 54.5% for 80% wheat flour + 20% corn flour [control 2 (C2)].

The arrival time, dough development, dough stability and degree of weakening were not affected in (T6) compared with wheat flour (C1). While, in (T3), the sample contained chemical additives and food additives increased in water absorption (55.7%), arrival time (2.5 min), dough development (3.0 min) and dough stability (4.5 min) compared with 54.5 for 80% wheat flour + 20% corn flour. Also, from the same table, it could be observed that, the stability of (T2) was 2.5, 3., 3.0, 3, 1.5 and 3 min, respectively, compared with (C2) 4 min.

Water absorption decreased in most treatments except (T3) and (T6) compared with (C2).

Also, from the same table it could be noticed that, stability of dough produced from 80% wheat flour + 20% corn flour was 4 min, while it decreased in treatment prepared with additive calcium chloride. While, (T4) had also decreased in water absorption (49.5%). The water absorption of the sample (T3) was 55.7%. Arrival time of sample (T3) was 2.5 min, while it was 1.0 min for samples (T1) and (T5). Dough development time of sample (T5) was 1.5 min.

These results are nearly in agreement with Zakharava and Kazakov (1970) who found that with respect to the blend of

Table (3): Farinograph characteristics of dough as affected by different additives.

Sample	Water absorption (%)	Arrival time (min)	Dough development (min)	Dough stability (min)	Degree of weakening (B.U.)
C1	56.2	1.5	2.0	4.0	140
C2	54.5	1.0	2.0	4.0	130
T1	53.5	1.0	1.5	4.0	130
T2	53.8	1.5	2.0	3.0	160
T3	55.7	2.5	3.0	4.5	100
T4	49.5	1.5	2.0	4.0	120
T5	52.0	1.0	1.5	4.0	140
T6	56.6	1.5	2.0	3.5	40

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

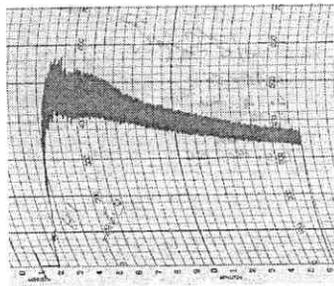
CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

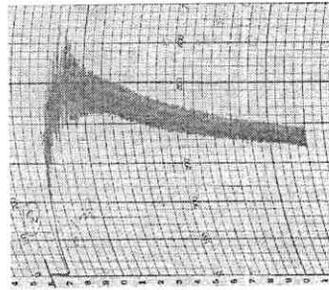
T3: C2 + DSF

T6: C2+ CD + CC + DSF + WP + SMP

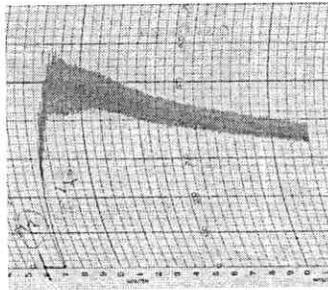
SMP: Skim milk powder (2.0 g)



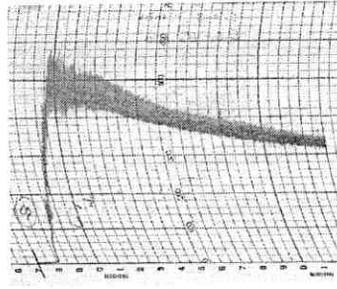
C1



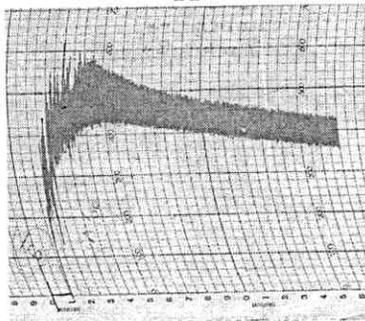
C2



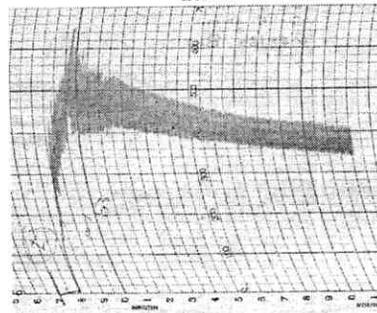
T1



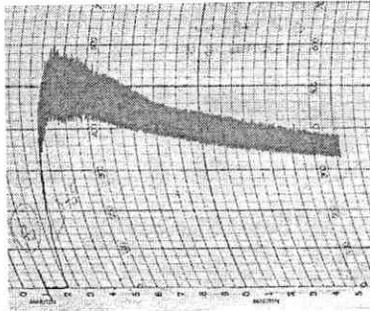
T2



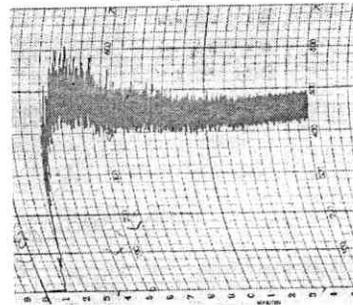
T3



T4



T5



T6

**Fig. (1): Diagram of farinograph for C1, C2, T1, T2, T3, T4, T5 and T6**

C1: Control (1) (100% wheat flour)

T1: C2 + CD

T3: C2 + DSF

T5: C2 + SMP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

SMP: Skim milk powder (2.0 g)

C2: Control (2) (80% wheat flour + 20% corn flour)

T2: C2 + CC

T4: C2 + WP

T6: C2 + CD + CC + DSF + WP + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

wheat flour of 82% extraction + 20% corn flour the farinograph test indicated that, the addition of calcium phosphate to flour increased water absorption and dough stability, while, decreased dough development. Meanwhile, mixing time was not affected.

#### **4.3.2. Extensograph parameters:**

Data in Table (4) and illustrated Fig. (2) show the effect of different additives added to wheat flour on extensograph parameters. From these results, it could be observed that, the extensibility (E) of dough produced from 80% wheat flour + 20% corn flour (C2) was decreased compared with dough produced from 100% wheat flour, also decreased in most treatments to which contained defatted soybean flour was added compared with (C2). These results are very close to the results reported by Hafez (1996) and Abdel-Moutaleb (2001).

Defatted soybean flour increased the resistance to extension (R) of dough,. This may be due to the induction of more hydrogen bonds in gluten-carbohydrate complex of dough, which reinforces the dough resistance. These results are in agreement with those reported by (Hafez, 1996).

In the same time, the proportional number (R/E) of dough increased with adding different improvers except calcium diphosphate and whey powder (T1 and T4) as shown in Table (4).

Energy values of dough prepared from different treatments were decreased compared with energy values of dough produced from 100% wheat flour except T3, T4 and T5 because no calcium salts were added to these treatments (Table, 4).

Table (4): Extensograph characteristics of dough as affected by different additives.

Sample	Resistance to extension (B.U.)	Extensibility (min)	Proportional number (R/E)	Energy (cm <sup>2</sup> )
C1	140	125	1.2	26
C2	140	90	1.6	18
T1	130	100	1.2	17
T2	140	80	1.8	14
T3	320	55	5.8	28
T4	180	120	1.5	26
T5	230	105	2.2	29
T6	250	25	10.0	6

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2 + CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

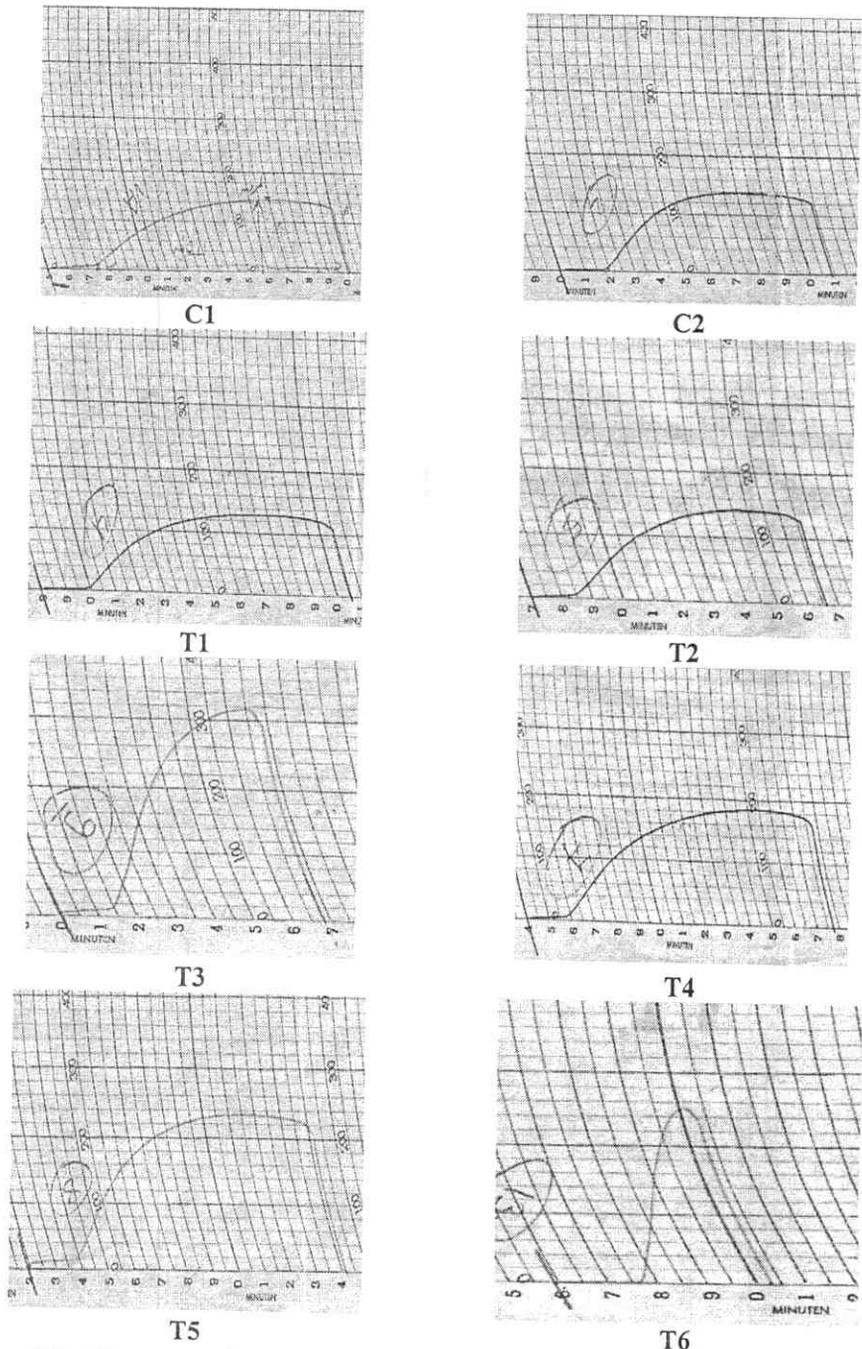


Fig. (2): Diagram of extensograph for C1, C2, T1, T2, T3, T4, T5 and T6

- |                                     |  |
|-------------------------------------|--|
| C1: Control (1) (100% wheat flour)  | C2: Control (2) (80% wheat flour + 20% corn flour) |
| T1: C2 + CD                         | T2: C2 + CC  |
| T3: C2 + DSF                        | T4: C2 + WP  |
| T5: C2 + SMP                        | T6: C2 + CD + CC + DSF + WP + SMP                  |
| CD: Calcium diphosphate (0.3 g)     | CC: Calcium Chloride (0.3 g)                       |
| DSF: Defatted soybean flour (5.0 g) | WP: Whey powder (2.0 g)                            |
| SMP: Skim milk powder (2.0 g)       |  |

#### 4.3.3. Falling number:

The falling number (FN) determination is commonly used to estimate  $\alpha$ -amylase activity in wheat meal and flour (Finney, 2001). Falling number is a practical indication used in the production of bakery products. It is used as an indicator for amylase activity (the greater the amylolytic activity, the shorter is the time required) of wheat flour dough and the effect of addition of other cereals and corn germ meal. The standard falling number is between 250-350 sec.

Data in Table (5) show that, the addition of corn flour to wheat flour decreased the falling number value and falling time compared with wheat flour. It was 280 sec for wheat flour, while it was 275 sec for sample of wheat + corn flour. The falling time was 220 sec for wheat flour while, it was 215 sec for the sample of 80% wheat flour + 20% corn flour.

The data of liquefaction number was increased by adding corn flour to wheat flour from 26.09 to 26.66%. This means that, the addition of corn flour increased the amylolytic activity of the dough.

These results are in agreement with findings of Seleem (2000) who found that addition of corn flour lead to decrease the falling number from 285 to 280 sec. This reduction was increased by increasing the addition of corn flour from 5 to 20%. Also, Farag (2003) and Mohy El-Din (2004) found that, the addition of corn flour decreased the falling number.

Data in Table (5) show that the addition of defatted soybean flour slightly decreased the falling number of sample

**Table (5): Falling number, falling time and liquefaction number of wheat flour 82% extraction rate with different additives.**

Samples	Falling number (F.N.)	Falling Time (F.T.)	Liquefaction number (L.N.)
C1	280	220	26.09
C2	275	215	26.66
T1	301	241	23.90
T2	306	246	23.44
T3	273	213	26.90
T4	273	213	26.90
T5	251	191	29.85
T6	246	186	30.61

\* On dry weight basis.

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

@: Carbohydrate calculated by difference.

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2+ CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

(T3), while, the addition of calcium salts (diphosphate or chloride) increased the falling number.

#### **4.4. Chemical composition of balady bread:**

Data in Table (6) show the chemical composition of the produced balady bread. It was observed that, of control balady bread (C1) contained  $38.89 \pm 0.02\%$  moisture, crude protein  $17.08 \pm 0.02\%$ , ether extract  $1.67 \pm 0.02\%$ , ash  $5.45 \pm 0.02\%$  and total carbohydrate  $75.80 \pm 0.02\%$  for (C1), while, moisture content was  $38.11 \pm 0.03\%$ , crude protein  $16.50 \pm 0.01\%$ , ether extract  $2.20 \pm 0.03\%$ , ash  $6.04 \pm 0.02\%$  and total carbohydrate  $75.26 \pm 0.02\%$  for (C2).

The addition of 20% of corn flour increased ether extract, ash and crude fiber of bread, while, it decreased the moisture and crude protein contents.

These results are in agreement with that mentioned by Ramadan (1986), Mohsen *et al.* (1997) and Seleem (2000).

Also, data in the same table show the addition of different improvers to have affected moisture content of balady bread.

Data in the same table show, significant difference in moisture content in all treatments compared with (C1). It had also significant difference compared with (C2) except sample (T2) which had significant difference with (C2).

The improvers increased the percentage of protein for all samples. Crude protein content of bread produced from (C2) was decreased compared with that produced from (C1).

Table (6): Chemical composition of produced balady bread from wheat flour and different additives (mean±SD).

Treatments	Moisture %	Total protein* %	Ether extract* %	Ash* %	Total carbohydrate* <sup>@</sup> %
C1	38.89±0.02	17.08±0.02	1.67±0.02	5.45±0.02	75.80±0.02
C2	38.11±0.03	16.50±0.01	2.20±0.03	6.04±0.00	75.26±0.02
T1	38.13±0.02	16.50±0.01	2.20±0.03	6.26±0.02	75.04±0.02
T2	38.13±0.03	16.50±0.03	2.20±0.01	6.37±0.03	74.93±0.02
T3	38.16±0.02	17.92±0.01	2.23±0.03	6.65±0.03	73.21±0.03
T4	38.38±0.37	16.68±0.03	2.20±0.02	6.26±0.03	74.86±0.03
T5	38.18±0.03	17.24±0.02	2.20±0.01	6.20±0.00	74.36±0.03
T6	38.24±0.02	18.83±0.03	2.27±0.02	6.85±0.02	72.05±0.04
LSD at 5%	0.16	0.50	0.05	0.03	0.04

\* On dry weight basis.

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

@: Carbohydrate calculated by difference.

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2+ CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

Ether extract content of all bread treatments had no significant difference compared with C2, while ash content and crude fiber had significant difference in all treatments compared with (C1) or (C2). Finally, total carbohydrate decreased with the additions of different additives.

#### **4.5. Minerals content of the produced balady bread:**

Data in Table (7) show that the addition of 20% corn flour to 80% wheat flour caused an increase in all minerals content except Mn which was decreased. The sample of bread produced from wheat flour (C1) had 0.07 mg/100 g of Zn, while, it was 2.59 mg/100 g for bread produced from 80% wheat flour + 20% corn flour (C2).

Bread of (T6) had the highest content of K, Mg, Ca, P, Mn, Fe, Cu and Zn compared with (C2) and other treatments. This may be due to the content of defatted soybean flour, whey powder and skim milk additives.

Most treatments of bread showed higher content of minerals. This may be due to the addition of different additives.

#### **4.6. Microbiological examination:**

Data in Table (8) indicated that total bacterial count increased with increasing storage period for bread produced from wheat flour (C1) and bread produced from 80% wheat flour + 20% corn flour (C2). The log number of total bacterial count ranged from 4.83 at zero time and was 7.2 of bread produced from C1 after 6 days. There were significant difference between bread samples during storage period.

**Table (7): Minerals content of produced balady bread from wheat flour and different additives (mg/100 g) (mean±SD) (on wet weight basis).**

Treatments	K	Mg	Ca	Na	P	Mn	Fe	Cu	Zn
C1	151.33	144.77	27.86	169.17	171.23	1.63	1.63	0.46	0.07
C2	238.45	234.65	41.37	217.42	222.56	1.38	2.98	0.82	2.59
T1	238.45	234.65	56.37	217.42	237.56	1.38	2.98	0.82	2.59
T2	238.45	234.65	71.37	217.42	222.56	1.38	2.98	0.82	2.59
T3	245.30	245.37	50.35	219.28	232.74	1.57	3.95	1.01	3.00
T4	282.65	238.89	43.11	233.64	239.80	1.42	3.07	0.84	2.64
T5	269.45	239.69	67.17	228.56	242.96	1.42	3.04	0.86	2.62
T6	320.50	254.65	122.89	246.22	285.38	1.65	4.10	1.07	3.08

\* On dry weight basis.

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

@: Carbohydrate calculated by difference.

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2+ CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

Table (8): Sensory evaluation of produced balady bread from wheat flour and different additives (mean±SD).

Treatments	Taste (20)	Texture (15)	Crumb distribution (15)	Odor (10)	Appearance (10)	Crust color (9)	Roundness (6)	Separation of layers (5)	Overall acceptability (10)
C1	15.7±1.07	12.4±1.06	12.4±0.73	7.6±0.66	7.8±1.39	7.5±0.59	4.5±0.46	3.8±0.51	7.8±0.45
C2	13.7±1.72	12.5±1.09	11.7±0.67	7.7±0.56	7.3±0.89	6.7±0.56	4.4±0.59	3.4±0.41	6.4±0.39
T1	16.6±0.67	12.8±0.62	12.5±0.52	7.8±1.06	7.8±0.75	7.1±1.00	4.3±0.65	3.5±0.52	7.3±0.33
T2	18.0±0.43	13.7±0.49	13.3±0.45	8.2±0.72	8.2±0.58	7.8±0.45	4.5±0.67	4.1±0.51	7.6±0.17
T3	16.0±1.48	12.4±0.51	12.6±0.90	7.6±1.24	7.2±0.39	6.8±0.83	3.9±0.90	3.5±0.52	7.0±0.57
T4	17.3±1.60	12.5±1.31	12.2±1.85	8.4±0.79	8.1±0.67	7.5±1.17	4.7±0.89	4.2±0.58	7.5±0.65
T5	17.0±0.95	13.0±0.74	13.3±0.45	7.9±0.67	7.7±0.65	7.2±0.83	4.5±0.67	3.9±0.67	7.4±0.33
T6	15.3±2.34	12.4±1.51	12.3±1.36	7.7±1.44	7.8±1.19	7.0±1.13	4.5±1.09	3.8±0.62	7.7±0.81
LSD 5%	1.38	1.07	1.16	0.85	0.93	0.92	0.75	0.52	0.51

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2 + CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

Data in Table (8) indicated that, the total bacterial count were decreased in all treatments in zero time of storage compared with bread produced from 80% wheat flour (82% ext. rate) plus 20% corn flour (97% ext. rate) [control 2 (C2)]. Also, the total bacterial count was lower in all treatments through storage periods.

The decrease of total bacterial count may be due to the different additives especially chemical additives.

The log number of total bacterial count at first, second, fourth and sixth days were 0.59, 0.18, 0.15 and 0.28%, respectively for C2 compared with C1.

Log number of total bacterial count decreased for bread produced from T6. It was 2.49, 2.36, 2.19, 1.92 and 1.95% at zero time, first, second, fourth and sixth day, respectively.

After first day log number of total bacterial count was lower of sample T2 and T6. This is may be due to the effect of calcium chloride and calcium diphosphate.

Data in Table (9) show that the total moulds and yeasts increased with increasing storage period for C1 and C2. The log number of total moulds and yeasts was ranged from 2.23 for C2 at zero time to 4.26 for C1 after 6 days. The difference between samples during storage period and treatments are shown in the same table. The log number of moulds and yeasts for treatment of C2 was lower comparing with C1. This is may be due to added the addition of corn flour.

The log number of molds and yeasts of bread sample of C1 at zero time was 2.28, by adding corn flour, the log number

become 2.23. The percentage of changes was 2.19. By increasing storage period, the log number of molds and yeasts increased.

Data in Table (9) indicated that total moulds and yeasts increased with increasing storage period for C2 and all treatments. The log number of moulds and yeasts were ranged from 2.15 for T1 at zero time to 2.30 for T5.

There were a significant difference between each sample during storage period as shown in the Table. The log number of moulds and yeasts count for all treatments were significantly low by comparing with control (C2).

Data in Table (9) indicated that the log number of moulds and yeasts of C2 at zero time was 2.23 but T6 was 2.15. This is due to that the sample of (T6) contained calcium disphosphate and calcium chloride.

It also showed that by increasing storage period the log number of moulds and yeasts increased with the log number of T6 compared to the control 2 (C2).

The percentage changes of log number was 3.59, 3.25, 3.67, 2.59 and 1.89% at zero time and after first, second, fourth and sixth day, respectively. The log number of T1 at zero time was 2.15.

After first day log number of T1 was 2.38 for. After second day log number was 2.53 and percentage changes percent was 8.81%. The log number was 3.23 after the fourth day. The percentage changes was 7.18%. While it was 4.15 after sixth day for the sample of T2. The percentage changes was 1.89% for sample T6.

Table (9): Total bacterial count of produced balady bread from wheat flour and different additives.

Treatments	Zero time			After 1 day			After 2 days			After 4 days			After 6 days		
	Number of survival (x10 <sup>4</sup> )	Log number	Change %	Number of survival (x10 <sup>4</sup> )	Log number	Change %	Number of survival (x10 <sup>5</sup> )	Log number	Change %	Number of survival (x10 <sup>6</sup> )	Log number	Change %	Number of survival (x10 <sup>7</sup> )	Log number	Change %
	C1	6.9	4.83	-	13.0	5.11	-	3.0	5.49	-	6.2	6.79	-	1.6	7.20
C2	6.6	4.82	-	12.2	5.08	-	3.0	5.48	-	6.0	6.78	-	1.5	7.18	-
T1	4.7	4.67	-3.11	8.5	4.93	-2.95	2.1	5.32	-2.92	4.3	6.63	-2.21	1.0	7.00	-2.51
T2	4.5	4.65	-3.53	8.2	4.91	-3.35	2.0	5.30	-3.28	4.1	6.61	-2.51	1.0	7.00	-2.51
T3	6.2	4.79	-0.62	11.3	5.05	-0.59	2.8	5.44	-0.73	5.6	6.75	-0.44	1.4	7.15	-0.42
T4	5.3	4.72	-2.07	9.6	4.98	-1.97	2.4	5.38	-1.82	4.8	6.68	-1.47	1.2	7.08	-1.39
T5	6.0	4.78	-0.83	10.9	5.03	-0.98	2.8	5.44	-0.73	5.4	6.73	-0.74	1.4	7.15	-0.42
T6	5.0	4.70	-2.49	9.1	4.96	-2.36	2.3	5.36	-2.19	4.5	6.65	-1.92	1.1	7.04	-1.95
LSD for log number of storage period (A) at 5%															
LSD for log number of treatments (B) at 5%															
LSD for log number of A x B at 5%															

\* On dry weight basis.

- C1: Control (1) [100% wheat flour]
- T1: C2 + CD
- T4: C2 + WP
- CD: Calcium diphosphate (0.3 g)
- DSF: Defatted soybean flour (5.0 g)

@: Carbohydrate calculated by difference.

- C2: Control (2) [80% wheat flour + 20% corn flour]
- T2: C2 + CC
- T5: C2 + SMP
- CC: Calcium Chloride (0.3 g)
- WP: Whey powder (2.0 g)
- T3: C2 + DSF
- T6: C2 + CD + CC + DSF + WP + SMP
- SMP: Skim milk powder (2.0 g)

#### **4.7. Organoleptic evaluation of balady bread produced from wheat flour and different additives:**

Data in Table (10) show that, the addition of 20% corn flour had an effect on the quality parameters of bread than that produced by using wheat flour without additives (C1).

Organoleptic evaluation of balady bread produced from wheat flour and different additives (Table, 10) showed significant differences between bread of C1 and C2. It was 7.76% and 7.31%, respectively.

On the other hand, taste, texture, crumb distribution, odor, appearance, crust color, roundness, separation of players and overall acceptability were 15.7, 12.4, 12.4, 7.6, 7.8, 7.5, 4.5, 3.8 and 7.8, respectively, for bread produced from wheat flour. While, bread produced from 80% wheat flour plus 20% corn flour improved texture (12.5) and odor (7.7) compared with bread produced from 100% wheat flour (C1).

Crust color of bread of T4 had higher score than that of bread (C2). It was 6.69 for bread (C2), while it was 7.50 for bread of (T4). This may be due to the lactose of whey powder and milk powder, which interacts with amino acid of defatted soybean flour.

Data in Table (10) indicated that (C1) was significantly better than (C2) in taste and overall acceptability. No significant difference in the other characteristics was noted between (C1) and (C2).

These results are in agreement with Hegazy (2002).

Table (10): Total moulds and yeasts count of produced balady bread from wheat flour and different additives.

Treatments	Storage period (days)														
	Zero time			After 1 day			After 2 days			After 4 days			After 6 days		
	Number of survival ( $\times 10^2$ )	Log number	Change %	Number of survival ( $\times 10^5$ )	Log number	Change %	Number of survival ( $\times 10^2$ )	Log number	Change %	Number of survival ( $\times 10^3$ )	Log number	Change %	Number of survival ( $\times 10^4$ )	Log number	Change %
C1	1.9	2.28	-	3.0	2.48	-	4.2	2.62	-	3.1	3.49	-	1.8	4.26	-
C2	1.7	2.23	-	2.9	2.46	-	4.1	2.61	-	3.0	3.48	-	1.7	4.23	-
T1	1.4	2.15	-3.59	2.4	2.38	-3.25	3.4	2.53	-3.07	2.5	3.39	-2.59	1.4	4.15	-1.89
T2	1.4	2.15	-3.59	2.4	2.38	-3.25	3.4	2.53	-3.07	2.5	3.39	-2.59	1.4	4.15	-1.89
T3	1.6	2.20	-1.35	2.4	2.38	-3.25	3.8	2.57	-1.53	2.8	3.45	-0.86	1.6	4.20	-0.71
T4	1.4	2.15	-3.59	2.4	2.38	-3.25	3.4	2.53	-3.07	2.5	3.39	-2.59	1.4	4.15	-1.89
T5	1.4	2.30	-3.59	2.4	2.38	-3.25	3.8	2.57	-1.53	2.8	3.45	-0.86	1.6	4.20	-0.71
T6	1.4	2.15	-3.59	2.4	2.38	-3.25	3.4	2.53	-3.07	2.5	3.39	-2.59	1.4	4.15	-1.89
LSD for log number of storage period (A) at 5%															
LSD for log number of treatments (B) at 5%															
LSD for log number of A x B at 5%															

\* On dry weight basis.

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

@: Carbohydrate calculated by difference.

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2 + CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

#### **4.8. Staling of balady bread produced from wheat flour with different additives:**

##### **4.8.1. Alkaline water retention capacity (AWRC):**

Data in Table (11) and illustrated in Fig. (3) show the alkaline water retention capacity (AWRC) of balady bread produced from wheat flour with different additives at zero, 24, 48 and 72 hr after baking. The data revealed that a decrease in AWRC took with different additives added to the flour. This decrease in AWRC retarded staling compared to control.

From the same table, it could be observed that, the rate of AWRC of bread produced from 80% wheat flour + 20% corn flour after 8 hrs was lower comparing with the rate of AWRC of balady wheat bread (C1). The rate of decrease for bread produced by using T2 was 11.02%, while, the rate of decrease for balady wheat bread (C1) was 4.01%. After 24 hr, the rate of AWRC of bread of (T2) was 21.30% compared with 15.09% of bread (C1).

Alkaline water retention capacity (AWRC) is a simple and quick test to follow staling of bread. From the alkaline water retention capacity which reflect the swelling power of the starch granules and in other words staling or retrogradation. It could be concluded that, the presence of slight amounts of oil delayed the staling and improved somewhat the freshness of the produced baked products.

From the same table, the alkaline water retention capacity as swelling power (S.P.) of balady bread stored at zero, 8, 24, 48 and 72 hrs after baking are also shown. The data revealed that a

Table (11) Alkaline water retention capacity (AWRC) of produced balady bread from wheat flour (82% ext. rate) with different additives.

Treatments	Storage period (hr)												
	After 8 hr			After 24 hr			After 48 hr			After 72 hr			
	AWRC after zero time	AWRC	Rate of decrease (%)	AWRC	Rate of decrease (%)	AWRC	Rate of decrease (%)	AWRC	Rate of decrease (%)	AWRC	Rate of decrease (%)	AWRC	Rate of decrease (%)
C1	418.71	401.90	-4.01	355.49	-15.09	302.13	-27.84	285.48	-31.82				
C2	386.54	332.17	-14.07	284.59	-26.38	237.92	-38.45	217.60	-43.71				
T1	368.73	330.01	-10.50	293.39	-20.43	268.65	-27.14	256.37	-30.47				
T2	357.18	317.81	-11.02	281.10	-21.30	261.17	-26.88	244.34	-31.59				
T3	387.00	355.49	-8.14	309.67	-19.98	285.18	-26.31	277.78	-28.22				
T4	395.12	353.03	-10.65	308.32	-21.97	294.48	-25.47	272.00	-31.16				
T5	387.10	352.26	-9.00	315.37	-18.53	301.24	-22.18	285.83	-26.16				
T6	411.37	390.40	-5.10	364.30	-11.44	313.09	-23.89	307.37	-25.28				

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

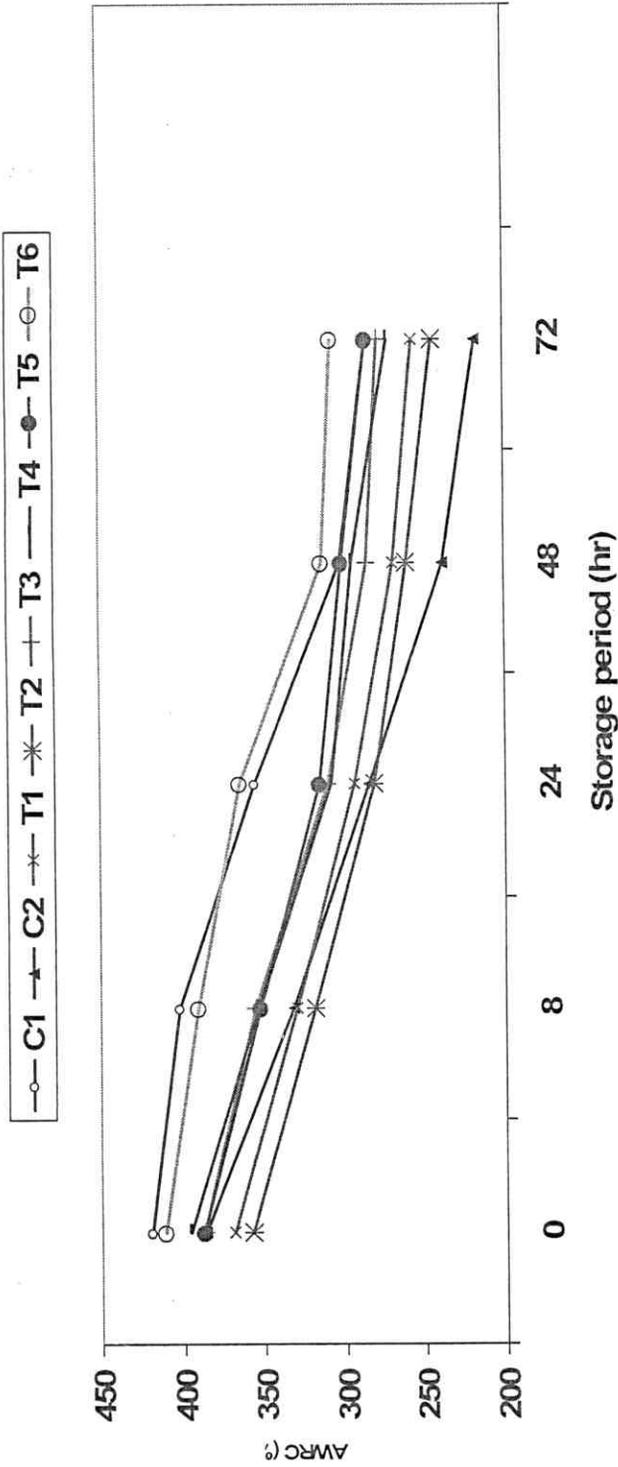
CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2+ CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)



**Fig. (3): Effect of some additives to wheat flour on alkaline water retention capacity during storage period**  
 C1: Control (1) (100% wheat flour)  
 T1: Control (1) (100% wheat flour) + 20% corn flour  
 C2: Control (2) (80% wheat flour + 20% corn flour)  
 T2: C2 + CC  
 T3: C2 + DSF  
 T4: C2 + WP  
 T5: C2 + SMP  
 T6: C2 + CD + CC + DSF + WP + SMP  
 CC: Calcium Chloride (0.3 g)  
 WP: Whey powder (2.0 g)  
 DSF: Defatted soybean flour (5.0 g)  
 SMP: Skim milk powder (2.0 g)

decrease in AWRC took place with the addition of corn flour and other additives.

The addition of defatted soybean and dried skim milk increased the staling period compared with control bread (C2) and the other bread treatments. This may be due to crystallization of amylose after baking processing during bread storage. These results are in agreement with those of Khorshid *et al.* (1996) and Salah (2005).

The same Table show that (C1) is the best when compared to (C2). This may be due to the higher percentage of adding corn flour. After zero time all samples increased in AWRC than that of (C2). This is due to the effect of defatted soybean flour, whey powder and skim milk powder.

The loss of freshness of control was 31.82 and for control 2 was 43.71. The results of freshness of all samples are better than that of C2 (Table, 11). The best sample in freshness was T6. This is may be due to the addition of defatted soybean flour, skim milk powder and whey powder.

#### **4.8.1. Moisture content of balady bread loaves:**

Water plays a critical role in bread staling. Softening of crust and hardening of the crumb are related to moist redistribution during storage (Baik and Chinachoti, 2000).

Data in Table (12) and illustrated in Fig. (4) showed the moisture content of loaves that varied between the studied samples. After baking (zero time), the moisture content of bread of wheat flour was 38.89% and was 38.11% for wheat corn

Table (12): Effect of different additives on moisture content of balady bread during storage period at room temperature.

Treatments	Storage period (hr)												
	Zero time (%)	After 8 hr			After 24 hr			After 48 hr			After 72 hr		
		Moisture content (%)	Rate of decrease (%)	Moisture content (%)	Rate of decrease (%)	Moisture content (%)	Rate of decrease (%)	Moisture content (%)	Rate of decrease (%)	Moisture content (%)	Rate of decrease (%)	Moisture content (%)	Rate of decrease (%)
C1	38.89	36.48	-6.20	32.97	-15.22	27.53	-25.00	25.00	-35.72				
C2	38.11	33.26	-12.73	29.95	-21.41	25.59	-32.85	19.76	-48.15				
T1	38.13	34.67	-9.07	30.86	-19.07	28.33	-25.70	27.06	-29.03				
T2	38.13	34.48	-9.57	30.54	-19.91	28.43	-25.44	26.63	-30.16				
T3	38.16	35.60	-6.71	31.07	-18.58	28.67	-24.87	27.94	-26.78				
T4	38.38	34.66	-9.69	30.39	-20.82	28.97	-24.52	26.80	-30.17				
T5	38.18	35.29	-7.57	31.69	-17.00	30.26	-20.74	28.78	-24.62				
T6	38.24	36.84	-3.66	34.41	-10.02	29.65	-22.46	29.12	-23.85				

C1: Control (1) [100% wheat flour]

T1: C2 + CD

T4: C2 + WP

CD: Calcium diphosphate (0.3 g)

DSF: Defatted soybean flour (5.0 g)

C2: Control (2) [80% wheat flour + 20% corn flour]

T2: C2 + CC

T5: C2 + SMP

CC: Calcium Chloride (0.3 g)

WP: Whey powder (2.0 g)

T3: C2 + DSF

T6: C2 + CD + CC + DSF + WP + SMP

SMP: Skim milk powder (2.0 g)

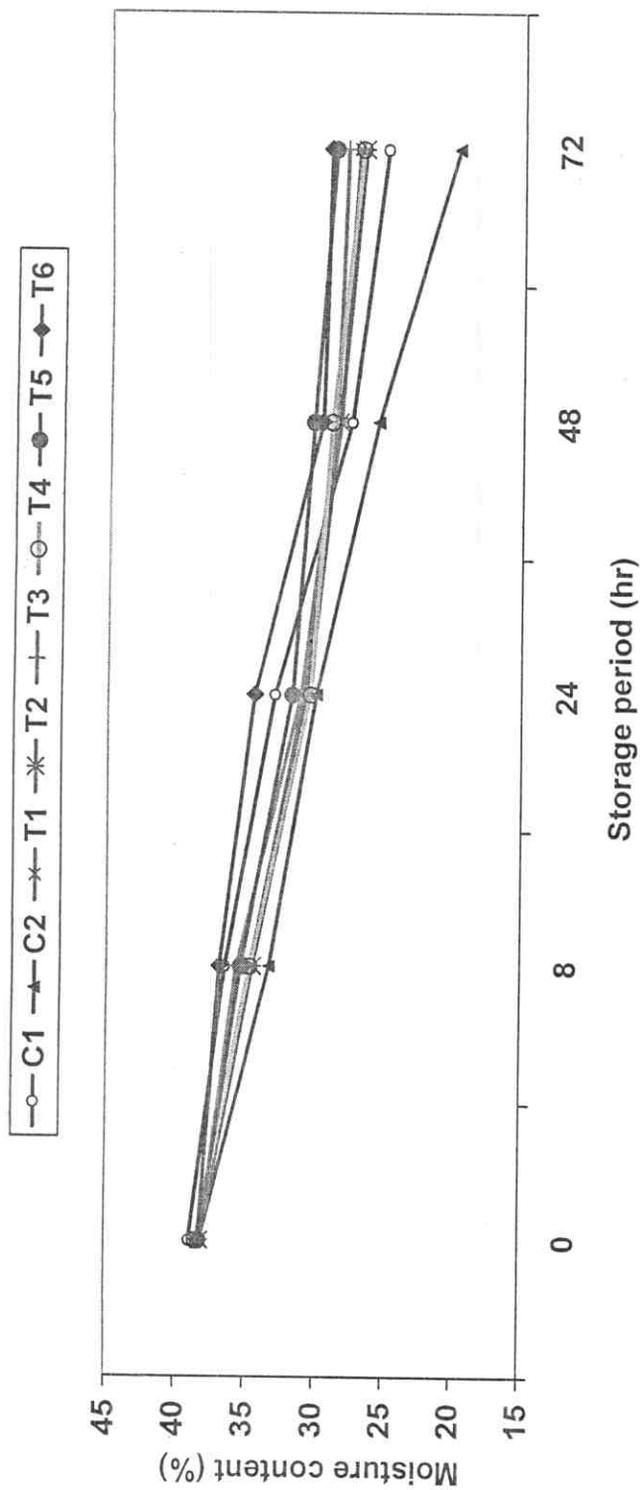


Fig. (4): Effect of some additives to wheat flour on moisture content during storage period

C1: Control (1) (100% wheat flour)

C2: Control (2) (80% wheat flour + 20% corn flour)

T1: C2 + CD

T2: C2 + CC

T3: C2 + DSF

T4: C2 + WP

T5: C2 + SMP

T6: C2 + CD + DSF + WP + SMP

CD: Calcium diphosphate (0.3 g)

CC: Calcium Chloride (0.3 g)

DSF: Defatted soybean flour (5.0 g)

WP: Whey powder (2.0 g)

SMP: Skim milk powder (2.0 g)

bread. The moisture content was determined after 2, 8, 24, 48 and 72 hr. The loss of moisture content increased by increasing storage period.

After 24 hrs of baking the loss of moisture content of wheat balady bread from control 1 (C1) was 15.22% compared with 21.41% for wheat corn bread from control 2 (C2).

After 48 hrs, the loss percentage increased ranged from 25.0 to 32.85 for wheat corn bread.

These results are in agreement with Seleem (2000), Hegazy (2002) and Mohy El-Din (2004) who found that increasing the percentage of corn and storage period increased moisture loss in bread. The results showed that the moisture content of wheat bread was 38.54%, 32.97% and 27.82% at zero time and after 24 and 48 hrs, respectively. Moreover, the moisture content for wheat corn bread were 39.31, 31.84, 25.31% and 20% at zero time and after 24 and 48 hrs, respectively.

Cuchajowska and Pomeranz (1989) observed that during storage of bread, the water content of the crust increased during the storage period as a result of water transport from the crumb in a zone near the crust.

From the above results it could be noticed that the addition of corn flour caused more reduction in moisture content accompanied by increasing the stale rate of bread.

The rate of decrease in moisture content was lower in all bread treatments compared with bread C2. The different additives increased moisture retention of bread samples and retarded staling.

These results are in agreement with Seleem (2000), Hegazy (2002) and Mohy El-Din (2004).