EFFECT OF ADDITION ASCORBIC ACID, EGG YOLK AND WHEY POWDER ON PAN BREAD CHARACTERISTICS

By

Mohamed, M.H.*; Soliman, S.A.*; Abd El-Latif, B.M.**

and Mourad, A.A.**

*** Food Sci. Dept., Fac. of Agric. Moshtohor, Zagazig Univ.**

**** Food Technl. Research Institute, Agric. Center Research**

ABSTRACT

Pan bread supplemented with fortification materials (ascorbic acid, egg yolk and whey powder). Chemical composition of raw materials and the bread was determined. Rheological properties of dough and the stability of vitamin C during different period or phase were evaluated for dough and pan bread. Physical and sensory characteristics of fortified pan bread were studied. The results indicated that the addition of a combination of 3 g dried egg yolk, 3 g dried whey and 18 mg ascorbic acid/100 g flour is the best ratio which improved the rehological properties, physical sensory characteristics and. chemical composition for dough and pan bread.

INTRODUCTION

Milk and egg proteins were used in food products for their nutritional value and emulsifying, foaming and heat gelation properties.

Functional properties of milk – egg mixtures need to be characterized to predict their performance in food formulations. (Cayot and Lorient, 1998).

Ascorbic acid is unstable in processed foods because it oxidized and destroyed by air in the combined presence of moisture and certain metal ions. To increase intake of vitamin C in the general population, it may be necessary to fortify stable foods. (Liao and Seib, 1988).

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).

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. They 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.

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%..

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.

Gelinas and Lachance (1995) evaluated dough water absorption, peak time and mixing stability on samples. 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.

The resistance to extension of dough was lowered when using of whey solids with wheat flour by addition of dried whey to flour at 3-15%, Srivastava *et al.* (1996). The addition of 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).

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).

Arnoczky *et al.* (1996) found that whey protein increased the loaf volume and lowered the rate of staling in optimally baked bread as in bread baked by the fixed formula.

Srivastava *et al.* (1996) studied the effect of adding whey solids at the level of 3 g to the bakery products. They found that color, texture and taste of products were improved. However, increasing the level of whey solids to 10% improved nutritional value.

The purpose of this study was planned to use L- ascorbic acid, egg yolk powder and whey powder in pan bread for improve reological properties, physical and or sensory characteristics.

MATERIALS AND METHODS

Materials

Wheat flour (Hard red spring 72% extraction rate) was obtained from Food Technology Research Institute, Agric. Res. Center, Giza. Yolk powder and whey powder were obtained from Garss Co. India Crystalline L-ascorbic acid was purchased from BDH, Dorset, England.

Methods

1. Preparation of Pan bread blends:

Different blends using yolk powder, whey powder and L-ascorbic acid were sublimated as follows:

1. Control (wheat flour 72% extraction rate)
2. Wheat flour + (2 mg ascorbic acid/100 g flour).
3. Wheat flour + (8 mg ascorbic acid/100 g flour).
4. Wheat flour + (18 mg ascorbic acid/100 g flour).
5. Wheat flour + 1 g Egg yolk powder/100 g flour.
6. Wheat flour + 3 g Egg yolk powder/100 g flour.
7. Wheat flour + 1 g whey powder/100 g flour.
8. Wheat flour + 3 g whey powder/100 g flour.
9. Wheat flour + (1 g egg Yolk,1 g whey and 8 mg ascorbic acid/100 g flour).
10. Wheat flour + (3 g egg Yolk, 3 g whey and 18 mg ascorbic acid/100 g flour).

2. Rheological properties of dough formulas:

Physicochemical properties of which made from different blends were evaluated using Brabender Farinograph according to the method described in AACC (1983).

3. Falling No. of Wheat Flour :

The falling No. of wheat flour were determined according to A.A.C.C. (1983).

4. Baking procedure

Bread was prepared by straight dough method according to the method (Faridi and Rubenthaler, 1984). The total formula was consisted of : 500 g flour, 5 g active dry yeast (*Saccharomyces servisia)*, 25 g sugar, 5 g sodium chloride, 25 ml corn oil.

5. Chemical analysis:

Moisture, crude protein, ash contents and ether extract according to the methods described in A.O.A.C. (1990). Total carbohydrates were determined by difference.

Sodium, potassium, calcium, iron, copper, magnesium, manganese and zinc were determined by A.O.A.C methods (1990). Phosphorus was determined by spectrophotometery at 650 µm according to the method described in A.O.C.S (1973).

Ascorbic acid was determined in dough and the products of fortified Pan bread according to the method described by Vanderslice and Higgs (1988).

6. Pan bread physical characteristics

The average weight of loaves was recorded after cooling the loaves for 3 hrs.

The loaf volume was measured by rapeseed displacement method as described by A.A.C.C. (1983).

Specific volume (cm^3/g) was calculated by dividing volume of the loaf by its weight by Colims *et al*. (1982).

7. Sensory evaluation

The prepared pan bread product was evaluated for their sensory characteristics by ten panelists from the staff of the Food Tech. Res Institute, Agric. Res. according to: Gelinas and Lachance (1995)

8. Statistical analysis:

The sensory evaluation of the produced bakery products were statistically analyzed by Analysis of variance (ANOVA) and determination of Least Significant Difference (L.S.D.) according to the method of Hills (1996) and statistically analyzed according to the methods of SAS (1993).

9. Staling of pan bread loaves:

Staling rate of bread was determined using Penetrometer apparatus according to the method described by Maleki *et al*. (1980). Bread was stored in sealed polyethylene bags at room temperature.

RESULTS AND DISCUSSION

1. Chemical composition and mineral contents 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 those results are in agreement with those reported by Cerbulis *et al.* (1972), Hassan *et al.* (1991), El–Badrawy (1994) and Stadelman and Cotterill (1995).

Mineral contents of wheat flour, egg yolk and whey powder are presented in Table (2) there are differentiation in the percentage of each mineral except manganese. The difference in any mineral in wheat flour or egg yolk will be combined from each other. So the addition of them will be improve the nutrational value of pan bread.

2. Rheological properties:

Farinogram properties of doughs with ascorbic acid, egg yolk and whey powder were recorded as shown in Table (3). 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, but 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.

Resistance to extension, extensibility, proportional number and energy of the extensogram properties of dough are shown in Table (3). They were affected by fortification with ascorbic acid, egg yolk and whey powder.

From the same Table, the dough which 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 than that of control sample. So, we with are canceled the other blends.

These results are in agreement with Srivastava *et al.* (1996) and Christy *et al.* (1998).

3. Chemical composition of pan bread from the previous results:

Chemical composition of pan bread (control) and pan bread fortified with egg yolk, whey powder and ascorbic acid are presented in Table (4). Moisture content of all samples of pan bread had nearly the same value. The protein content and ether extract 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.

Table (4): Chemical composition of pan bread (control) and pan bread fortified with ascorbic acid, egg yolk and whey powder.

Samples	*Total crude Protein	*Ether extract	*Ash content	*Total carbohyd -rates	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.**

4. 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 (5). From the results, it is

shown that pan bread fortified with 3 g egg yolk, 3 g whey and 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.

These results are in agreement with Birch and Finney (1980), Kulp *et al.* (1988) and Srivastava *et al.* (1996).

Table (5): Effect of fortified wheat flour with ascorbic acid, egg yolk and whey powder on the physical properties of pan bread.

Samples	Weight (g)	Volume (cm^3)	Specific volume (cm^3/g)	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 I 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

5. Organoleptic properties of pan bread:

Sensory characteristics of pan bread containing different levels of ascorbic acid, egg yolk and whey powder a combination of fortification materials are presented in Table (6). The measured sensory characteristics included external characteristics (crust color, symmetry, evennes of bake, character of crust and break and shared), 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 and 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.

These results are in agreement with Ludewig (1982), Cubakowski *et al.* (1983), Vitti and Etoredo-Valle (1987) and Srivastava *et al.* (1996).

6. Stability of Ascorbic acid:

Ascorbic acid 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 was presented in Table (7). The percentage of the retained of ascorbic acid was decreased by 3% in dough after fermentation. While after making the bread retained of ascorbic acid 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 ascorbic acid. 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.

These results are in agreement with Elkassabany and Hoseney (1980), Seib (1985) and Park *et al.* (1994).

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

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

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

Data in Table (8) shows that 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 combination of egg yolk, whey and ascorbic acid.

Table (9) shows the staling rate of pan bread fortified with two different levels of fortified materials measured by Penetrometer. It is observed that pan bread fortified with was high level staled slower than other samples.

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

Table (8): 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.

Storage period (hour)	Samples of pan bread					
	1		2		3	
	Moisture %	Percentage decrease	Moisture %	Percentage decrease	Moisture %	Percentage decrease
0	37.62	-	37.17	-	37.28	-
24	33.25	11.62	33.64	9.50	35.86	3.81
48	30.49	18.95	31.32	15.74	34.75	6.79
72	28.75	23.58	29.69	20.12	33.80	9.33
96	27.57	26.71	28.50	23.32	33.00	11.48

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.

Table (9): Staling rate for pan bread fortified with egg yolk, whey and ascorbic acid after baking determining by Pentrometer as penetrometer unit (PU) in gm cm^{+-2}.

Storage period (hour)	Samples of pan bread					
	1		2		3	
	PU	Percentage decrease	PU	Percentage decrease	PU	Percentage decrease
0	243.66	-	292.33	-	356.33	-
24	180.66	25.86	259.66	11.18	336.33	5.62
48	145.66	40.22	234.33	19.84	321.33	9.82
72	101.33	58.41	210.00	28.16	297.66	16.47
96	nd	-	169.00	42.19	268.30	24.70

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.
nd: no determined.

8. Organoleptic properties of pan bread:

Sensory characteristics of pan bread were done in Table (10). The results indicated that generally, there were significant differences between pan bread fortified with ascorbic acid, egg yolk and whey during storage periods and pan bread (control). It could be concluded that the increase of the combination of ascorbic acid, egg yolk and whey caused a decrease in the staling rate of pan bread fortified with these materials.

These results are in agreement with Kamat *et al.* (1976).

9- Mineral contents of pan bread:

The mineral contents of pan bread are shown in Table (11). It could be seen that bread fortified with 3 g egg yolk, 3 g whey and 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 (11): 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)	116.70	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.

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